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# Final Best Demonstrated Available Technology (BDAT) Background Document for K086 (Ink Formulation Equipment Cleaning Wastes). Volume 7

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# FINAL
# BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR

# K086 (INK FORMULATION EQUIPMENT CLEANING WASTES)

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# 1. INTRODUCTION AND SUMMARY

K086 is defined as "solvent washes and sludges, caustic washes and sludges, or water washes and sludges from cleaning tubs and equipment used in the formulation of ink from pigments, driers, soaps and stabilizers containing chromium and lead" (40 CFR 261.32). Although these listing criteria suggest three treatability groups, the Agency believes that it is unnecessary to subcategorize this waste code (beyond subcategorization of wastewaters and nonwastewaters).

To date, only the solvent wash form of K086 has been regulated. This was done as part of the First Third rulemaking (53 FR 31138, August 17, 1988). Since promulgation of the final rule for the First Third, the Agency has obtained additional K086 waste characterization data and has performed additional analyses. This new information has enabled the Agency to re-evaluate the existing K086 treatment standards, to develop the final revisions for K086 (solvent washes), and to develop the final treatment standards and approach of all K086 wastes. Except for metals in K086 wastes, treatment standards promulgated today are based on revisions and existing standards for the corresponding P and U waste codes. The listing criteria for K086 wastes include several operations from the ink manufacturing process generating K086 wastes. Also, these criteria point out the presence of other listed wastes such as F001-F005 spent solvents and U or P wastes. (See Listing Background Document for K086 (USEPA 1980)). Since both K086 wastes and P and U wastes are likely to be commingled with other wastes for treatment by incineration, the Agency believes that it is appropriate for organic constituents of K086 to have the same treatment standard as their P and U counterparts or similar P or U waste.

In todays rule, EPA is adopting a modified approach for the November 22, 1989, proposed rule (54 FR 48372) revisions for K086 (solvent wash)

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including the addition of seven new constituents for regulation and to revise the August 17, 1988, promulgated treatment standards for them. The proposed revisions relied exclusively on incineration performance data for the development of treatment standards. In response to comments, EPA modified and developed the proposed revisions to include treatment standards based on residuals generated from various wastewater treatment processes rather than incineration scrubber waters. (See Sections 4 through 7, for a discussion of these additional data.) The final revisions for K086 (solvent washes) would apply to all forms of K086 wastewaters and nonwastewaters. See Section 4 for detailed information regarding these revisions.

This background document presents the additional data and analyses that are the support for the promulgated K086 treatment standards. This background document is an addendum to the August 1988 background document for K086 solvent wash (USEPA 1988a).

The Agency has obtained additional waste characterization data regarding caustic washes, caustic wash sludges, and solvent wash sludges. These new data are presented in Appendix A of this addendum, including waste characterization data originally presented in the K086 solvent wash background document. In addition, the Agency contacted numerous ink formulators during development of the Third Thirds Proposed Rule (November 22, 1989) to obtain qualitative information regarding both K086 waste characterization and industry practices regarding K086 treatment and disposal. Based on analysis of both the old data and the new data, the Agency concludes that the best demonstrated available technology (BDAT) and the treatment standards for the various forms of K086 will be ased on the BDAT for the U and P counterparts.

For K086 wastewaters, BDAT treatment standards for organic constituents are based on treatment performance data generated from the

residuals of one or more wastewater treatment processes. Specifically, these performance data are transferred from EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for Wastewater Forms of Organic U and P Wastes and Multi-source Leachate (F039) for Which There Are Concentration-Based Treatment STandards, Volume A (USEPA 1990). (See Section 7.0 for a discussion of these transferred data).

BDAT treatment standards for the regulated organics and cyanides in K086 nonwastewaters are based on incineration. BDAT treatment standards for the regulated metals are based on hexavalent chromium reduction to trivalent chromium, followed by lime precipitation and sludge filtration with stabilization of the sludge. BDAT treatment standards for cyanide in wastewaters is based on cyanide oxidation.

Promulgated treatment standards for wastewater and nonwastewater forms of K086 are contained in Table 1-1 and Table 1-2. A number of differences exist between the treatment standards contained in Table 1-1 and Table 1-2 and the treatment standards promulgated for K086 solvent wash as part of the First Third rulemaking. These differences include the following:

- Addition of cyanide and expansion of the number of semivolatile organic constituents to incorporate the Agency's latest waste characterization data and analyses and

- Revision of numerical values of some treatment standards originally promulgated on August 17, 1988 (53 FR 31138).

- Revision for the withdrawal of cyclohexanone and methanol in K086 nonwastewaters originally promulgated in the August 17, 1988 (53 FR 31138).

Table 1-1 BDAT Treatment Standards for K086
(Wastewaters)

| Regulated Constituent | Maximum for any Single Grab Sample Total Composition (mg/l) |
|---|---|
| Acetone | 0.28 |
| Acetophenone | 0.010 |
| n-Butyl alcohol | 5.6 |
| Cyclohexanone | 0.36 |
| 1,2-Dichlorobenzene | 0.088 |
| Methyl isobutyl ketone | 0.14 |
| Methyl ethyl ketone | 0.28 |
| Cyanides (Total) | 1.9 |
| Chromium (Total) | 0.32 |
| Lead | 0.037 |

| Regulated Constituent | Maximum for any Composite Sample Total Composition (mg/l) |
|---|---|
| Bis(2-ethylhexyl)phthalate | 0.28 |
| Butylbenzylphthalate | 0.017 |
| Diethyl phthalate | 0.20 |
| Dimethyl phthalate | 0.047 |
| Di-n-butyl phthalate | 0.057 |
| Di-n-octyl phthalate | 0.017 |
| Ethyl acetate | 0.34 |
| Ethyl benzene | 0.057 |
| Methanol | 5.6* |
| Methylene chloride | 0.089 |
| Naphthalene | 0.059 |
| Nitrobenzene | 0.068 |
| Toluene | 0.080 |
| 1,1,1-Trichloroethane | 0.054 |
| Trichloroethylene | 0.054 |
| Xylenes (Total) | 0.32 |

*Standard for methanol is based on analysis of a composite sample using SW-846 Method 8000.

Table 1-2 BDAT Treatment Standards for K086
(Nonwastewaters)

| Regulated Constituent | Maximum for any Single Grab Sample Total Composition (mg/kg) |
|---|---|
| Acetone | 160 |
| Acetophenone | 9.7 |
| Bis(2-ethylhexyl)phthalate | 28 |
| n-Butyl alcohol | 2.6 |
| Butylbenzylphthalate | 7.9 |
| 1,2-Dichlorobenzene | 6.2 |
| Diethyl phthalate | 28 |
| Dimethyl phthalate | 28 |
| Di-n-butyl phthalate | 28 |
| Di-n-octyl phthalate | 28 |
| Ethyl acetate | 33 |
| Ethyl benzene | 6.0 |
| Methyl isobutyl ketone | 33 |
| Methyl ethyl ketone | 36 |
| Methylene chloride | 33 |
| Naphthalene | 3.1 |
| Nitrobenzene | 14 |
| Toluene | 28 |
| 1,1,1-Trichloroethane | 5.6 |
| Trichloroethylene | 5.6 |
| Xylenes (Total) | 28 |
| Cyanide (Total) | 1.5 |

| Regulated Constituent | Maximum for any Single Grab Sample TCLP (mg/l) |
|---|---|
| Chromium | 0.094 |
| Lead | 0.37 |

Except for the chromium (total) and lead treatment standards, standards for K086 solvent wash promulgated as part of the First Third rulemaking (see 53 FR 31138, August 17, 1988) are now superseded by the treatment standards finalized in the May 8, 1990, final rule.

For the applicability of the promulgated standards, a wastewater is defined as wastes containing less than 1 percent (weight basis) total suspended solids* and less than 1 percent (weight basis) total organic carbon (TOC). Waste not meeting this definition must comply with the promulgated treatment standards for nonwastewaters.

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* The term "total suspended solids" (TSS) clarifies EPA's previously used terminology of "total solids" and "filterable solids." Specifically, the quantity of total suspended solids is measured by Method 209C (total suspended solid dried at 103°C to 105°C) in Standard Methods for the Examination of Water and Wastewater, 15th edition (APHA, AQQA, and WPCF 1985).

# 2. INDUSTRIES AFFECTED AND WASTE CHARACTERIZATION

## 2.1 Industries Affected

The Agency has no new data that would change the description of the ink formulation industry contained in the K086 solvent wash background document.

## 2.2 Waste Characterization

The Agency has obtained information regarding K086 sludges and caustic/water wash wastes since promulgation of the First Third Final Rule. This information is presented in Table 2-1. Table 2-1 also contains the data regarding K086 solvent wash that were in the K086 solvent wash background document. Note that the liquid portion of the caustic wash, although consisting mostly of water, contains total organic carbon of 26,000 mg/l. This liquid is a nonwastewater under the Agency's definitions because its organic content is greater than 1 percent by weight. (In the K086 solvent wash background document (USEPA 1988a), wastewaters are defined as wastes containing less than 1 percent (weight basis) total suspended solids and less than 1 percent (weight basis) total organic carbon. Wastes not meeting this definition are considered nonwastewaters.)

Table 2-1 contains composition data for K086 solvent wash liquid wastes and sludge wastes and for K086 caustic wash liquid wastes and sludge wastes. The data for K086 solvent wash liquid wastes were reported in the K086 solvent wash background document (USEPA 1988a) and are repeated in Table 2-1 for convenience. The data for the caustic wash liquid and sludge wastes were obtained by sampling and analysis of one ink formulator's wastes (USEPA 1989c). The data for solvent wash sludge were obtained by sampling and analysis of another ink formulator's waste (Versar 1988a).

Table 2-1 K086 Waste Characterization Data

| BDAT reference number | Analyte | Untreated K086 solvent wash liquid waste concentration (mg/kg) (1) | Untreated K086 solvent wash liquid waste concentration (mg/kg) (1) | Untreated K086 caustic wash waste concentration Liquid (mg/l) (2) | Untreated K086 caustic wash waste concentration Sludge (mg/kg) (2) | Untreated K086 solvent wash sludge waste concentration (mg/kg) (3) |
|---|---|---|---|---|---|---|
| | Volatile Organics | | | | | |
| 222 | Acetone | CBI | - | 3 | ND | CBI |
| 21 | Dichlorodifluoromethane | - | - | ND | 6.5 | CBI |
| 225 | Ethyl acetate | - | 256,000 | ND | ND | CBI |
| 226 | Ethylbenzene | CBI | - | ND | ND | CBI |
| 34 | Methyl ethyl ketone | CBI | - | - | - | CBI |
| 229 | Methyl isobutyl ketone | CBI | - | ND | ND | CBI |
| 38 | Methylene chloride | CBI | - | 1.5 | 80 | CBI |
| 42 | Tetrachloroethene | - | - | 0.52 | ND | CBI |
| 43 | Toluene | CBI | - | 3.6 | 380 | CBI |
| 45 | 1,1,1-Trichloroethane | CBI | - | ND | 5.3 | CBI |
| 215-7 | Xylene (total) | CBI | - | ND | 9.1 | CBI |
| | Semivolatile Organics | | | | | |
| 53 | Acetophenone | - | - | ND | 19 | CBI |
| 70 | bis(2-Ethylhexyl)phthalate | CBI | - | ND | 37 | CBI |
| 232 | Cyclohexanone | CBI | - | ND | ND | CBI |
| 98 | Di-n-butyl phthalate | - | - | ND | 83 | CBI |
| | Isophorone | CBI | - | ND | ND | CBI |
| 121 | Naphthalene | CBI | - | ND | ND | CBI |
| | Metals | | | | | |
| 154 | Antimony | CBI | - | 0.57 | ND | CBI |
| 155 | Arsenic | - | - | 0.04 | 1.1 | CBI |
| 156 | Barium | CBI | 0.54 | 0.46 | 3,880 | CBI |
| 157 | Beryllium | - | - | ND | ND | CBI |
| 158 | Cadmium | CBI | 4.3 | 0.006 | 9 | CBI |
| 159 | Chromium (total) | CBI | 116.0 | 164 | 1,850 | CBI |
| 221 | Chromium (hexavalent) | CBI | - | 156 | 257 | CBI |
| 160 | Copper | - | - | 0.34 | 495 | CBI |
| 161 | Lead | CBI | 1.1 | 179 | 9,250 | CBI |
| 162 | Mercury | - | - | 0.03 | 1.1 | CBI |
| 163 | Nickel | CBI | 2.4 | 9.9 | 34.7 | CBI |
| 164 | Selenium | CBI | 0.5 | 0.6 | ND | CBI |
| 165 | Silver | CBI | 0.32 | 0.03 | 2.5 | CBI |
| 166 | Thallium | - | - | 2.2 | ND | CBI |
| 167 | Vanadium | - | - | ND | ND | CBI |
| 168 | Zinc | CBI | 1.1 | 0.22 | 183 | CBI |

Table 2-1 (Continued)

| BDAT reference number | Analyte | Untreated K086 solvent wash liquid waste concentration (mg/kg) (1) | Untreated K086 solvent wash liquid waste concentration (mg/kg) (2) | Untreated K086 Caustic Wash Waste Concentration Liquid (mg/l) (2) | Untreated K086 Caustic Wash Waste Concentration Sludge (mg/kg) (2) | Untreated K086 solvent wash sludge waste concentration (mg/kg) (3) |
|---|---|---|---|---|---|---|
| | Inorganics Other Than Metals | | | | | |
| | Chloride | - | - | 734 | 263 | CBI |
| 169 | Cyanide | CBI | - | 412 | 7,120 | CBI |
| 170 | Fluoride | - | - | 475 | 606 | CBI |
| | Sulfate | - | - | 1,420 | 574 | CBI |
| 171 | Sulfide | CBI | - | 25 | 131 | CBI |
| | Other | | | | | |
| | pH | CBI | 6.3 | 11.93 | 11.28 | CBI |
| | Dissolved solids | - | - | 71,700 | - | CBI |
| | Moisture | CBI | - | - | 456,000 | CBI |
| | Total organic carbon | CBI | - | 26,000 | 203,000 | CBI |
| | Total organic halide | - | - | 17 | 9.1 | CBI |
| | Oven volatiles at 105°C (%) | - | - | 90.44 | - | CBI |
| | Ash (%) | CBI | - | 4.6 | 15.96 | CBI |
| | Sulfur (%) | - | - | 0.1 | 0.18 | CBI |
| | Btu/lb (%) | CBI | 13,600 | <100 | <100 | CBI |
| | Carbon (%) | - | - | 3.03 | 22.8 | CBI |
| | Hydrogen (%) | - | - | 10.1 | 8.4 | CBI |
| | Nitrogen (%) | - | - | 0.28 | 1.63 | CBI |
| | Chlorine (%) | - | - | 0.1 | 0.88 | CBI |
| | Moisture by distillation | - | - | - | 47.65 | CBI |
| | Volatile matter at 950°F | - | - | - | 78.58 | CBI |
| | Total solids | CBI | 5,700 | - | - | CBI |
| | Organic ink pigments | - | 77,000 | - | - | CBI |
| | Ethyl alcohol | - | 667,000 | - | - | CBI |
| | Naphtha | CBI | - | - | - | CBI |

CBI Confidential Business Information.
- No analysis performed.
ND Not detected.

Sources: (1) USEPA 1988a (Table 2-3).
(2) USEPA 1989c.
(3) Versar 1988a.

The Agency has obtained no data for K086 water wash liquid wastes and sludge wastes. However, the Agency believes that the compositions of K086 water wash liquids and sludges are similar to the compositions of K086 caustic wash liquids and sludges because water washes and caustic washes are both water-based and because they are both usually used to clean equipment used to formulate similar (water-based) inks. Conceivably, K086 water wash liquids and sludges could contain higher water contents and lower waste constituent concentrations than their K086 caustic wash counterparts because the K086 water wash liquids and sludges lack the caustic cleaning agent. This suggests that K086 water wash liquids and sludges are easier to treat, or certainly no more difficult to treat, than their K086 caustic wash counterparts and that transfer of BDAT and treatment standards from K086 caustic wash to K086 water wash is appropriate.

Table 2-1 shows, as expected, that the sludges from K086 caustic washes and solvent washes contain higher solids contents than do the liquids. Also, the water content of the caustic wash liquids and sludges are higher than those of the solvent wash liquids and sludges. From a treatability standpoint, however, there are many more similarities than differences among the various wastes. Many of the same organic, inorganic, and metal constituents are present in all the wastes. Furthermore, all of the wastes, including the caustic wash liquid, have similar amounts of organics, cyanide, and metals. Although it is water-based, the caustic wash liquid waste does not meet the Agency's definition of wastewater. The similarities among the wastes strongly imply that the same treatment train for removing or destroying organics, cyanide, and metals is likely to be appropriate for each waste.

In addition, the Agency has contacted numerous generators or potential generators of K086 (Versar 1988b-d), has monitored technical literature of the ink formulation industry (Flick 1985, Leach 1988, NAPIM 1988), and

has maintained contact with the National Association of Printing Ink Manufacturers. Data from these activities indicate or confirm the following with regard to the business, technology, and operating practices of the printing ink manufacturing industry:

- About one million new ink formulations are prepared yearly and several million ink formulation specifications are retained on active file.
- Formulations are changed and retailored in response to customer needs, market forces, technology advances, and the availability of new or improved raw materials.
- Use of chromium- and lead-based pigments is decreasing.
- Use of organic pigments is increasing.
- Ink formulation tubs and equipment are cleaned between batches. Liquids and sludges resulting from cleaning operations are kept in vessels that are separate from the tubs used for ink formulation. Liquids resulting from cleaning operations are generally reused for cleaning. Vessels containing spent cleaning liquids and sludges are emptied periodically, e.g., weekly or monthly, into drums. The drums are shipped to a commercial treater for treatment and disposal.
- A few K086 generators appear to practice limited onsite recycle (e.g., distillation of solvent-containing wastes) or onsite pretreatment (e.g., neutralization) of K086 waste prior to shipment of the waste to a treater.
- Cleaning solutions--both solvent- and water-based--are reused many times for cleaning different formulations before the cleaning solutions are considered "spent."
- Plants generally formulate both solvent/oil-based inks and water-based inks.
- No evidence was found that ink formulation equipment dedicated exclusively to formulation of lead- and/or chromium-containing inks is used. No evidence was found that ink formulation cleaning wastes containing lead or chromium are segregated from ink formulation cleaning wastes that do not contain these metals.

# 3. APPLICABLE AND DEMONSTRATED TREATMENT TECHNOLOGIES

The Agency has identified no applicable and demonstrated technologies for K086 beyond those already described in the K086 solvent wash background document (USEPA 1988a).

For the reasons discussed below, the Agency believes that the applicable and demonstrated technologies for K086 solvent wash liquid are also applicable and demonstrated for K086 solvent wash sludge. For instance, incineration has been identified as an applicable technology for organics in solvent wash wastes (USEPA 1988a). This standard was revised to reflect detection levels in different wastes because the matrices used to generate the proposed standards were ash from burns of phthalate wastes (K024) and disulfoton wastes (K037), both unique matrices. Acetone and ethyl acetate are volatile organics while K024 and K037 raw wastes, from which proposed standards for these compounds were derived, are high in semivolatile compounds such as polynuclear aromatics (PNAs). EPA chose to base the promulgated standards on a matrix from incinerated wood-preserving wastes (K001 PCP and creosote) because these are complex matrices with high concentrations of many organic compounds, volatiles, semivolatiles, chlorinateds, and others, and, consequently, are particularly difficult to analyze. Detection limits from these compounds are therefore particularly achievable.

As with K086 solvent wash, K086 sludges can be fed to incinerators via conventional centrifugal pumps, positive displacement pumps, ram feeders, or screw feeders.

## 3.1 Nonwastewaters

Incineration is a destruction technology in which energy, as heat, is transferred to the waste to destabilize chemical bonds and destroy

hazardous organic constituents. Combustion gases from the incinerator are then fed to a scrubber system for cooling and removal of any entrained particulates and acid gases. In general, with the exception of liquid injection incineration, two residuals are generated by incinerator processes: ash and scrubber water.

Once organics are treated by incineration, the metals originally in the wastes are contained in the incineration residues such as scrubber water and ashes. Hexavalent chromium can be reduced to trivalent chromium, and the leachability of the trivalent chromium can be decreased by stabilization. However, dissolution of the incinerator ash in water may be needed for subsequent reduction of hexavalent chromium to trivalent chromium, e.g., by water-soluble reducing agents such as sodium bisulfite or the ferrous form of iron.

Similarly, organics in K086 wastes resulting from water or caustic cleaning of ink formulation tubs and equipment can also be treated by incineration. This treatment, however, may require relatively large amounts of supplemental fuel for proper incineration because of the high concentration of water in the wastes. At least one facility has reported treating K086 liquid wastes resulting from water or caustic washing by incineration.

## 3.2 Wastewaters

Another way of treating high water content K086 liquid waste includes decanting the liquid from the sludge, partially treating the liquid to precipitate a portion of the suspended and dissolved solids, and reusing the liquid. Wet air oxidation and chemical oxidation followed by carbon adsorption should also be considered applicable technologies for pretreatment of high water content K086 liquid wastewaters. Wet air oxidation is a destruction technology in which hazardous organic

constituents in wastes are oxidized and destroyed under pressure at elevated temperatures in the presence of dissolved oxygen. This technology is applicable for wastes composed primarily of water and up to 10 percent total organic constituents. Wet air oxidation generates one treatment residual: treated effluent. The treated effluent may require further treatment for hazardous organic constituents by carbon adsorption. The carbon is then incinerated and must meet nonwastewater standards. This process gives the option of incinerating a smaller amount of waste.

It is conceivable that biological treatment (including activated sludge) could be applicable for treatment of the organics in high water content K086 nonwastewaters and wastewaters. Biological treatment is a destruction technology in which hazardous organic constituents in wastewaters are biodegraded. This technology generates two treatment residuals: a treated effluent and a waste biosludge. Waste biosludge may be land disposed without further treatment if it is less than or equal to the BDAT nonwastewater treatment standards. Again, the Agency has no data regarding the performance of these technologies on K086 wastes or similar wastes. Thus, the Agency does not consider these technologies demonstrated for K086 wastes.

Other available technologies considered by the Agency are powdered activated carbon addition to activated sludge (PACT$^{R}$), granular activated carbon (GAC), and steam stripping (SS).

PACT$^{R}$ and GAC treatments are a combination of carbon adsorption and biological treatment in which hazardous organic constituents are biodegraded or selectively adsorped onto powder-activated carbon. This technology generates two treatment residuals: a treated effluent and spent carbon/biosludge. The spent carbon may be regenerated and recycled to the process or may be incinerated.

Steam stripping is a separation technology in which wastewaters containing volatile organics have the organics removed by application of heat using steam as the heat source. This technology generates one treatment residual: treated effluent. Emissions from steam stripping may require further treatment.

# 4. PERFORMANCE DATA

On August 17, 1988, the treatment standards promulgated for K086 wastes were based on the incineration of a K086 solvent wash. The incineration of this wash yielded an incineration scrubber wastewater and no ash. Characterization of K086 incineration scrubber waters showed that the organics from the untreated K086 solvent wash were substantially reduced but the metals were concentrated in the residue. Based on the above-mentioned characterization data of these incineration scrubber waters, EPA identified a metal-bearing wastewater with similar treatability characteristics to the K086 solvent wash that had been treated by hexavalent chromium reduction to trivalent chromium followed by excess lime precipitation and filtration. The wastewater treatment sludge derived from the treatment of this similar metal-bearing wastewater contained detection levels for volatile and semivolatile organics. Therefore, the Agency proposed and promulgated treatment standards for the K086 (solvent washes) nonwastewaters based on the highest detection limit of the organic constituents in this similar wastewater treatment sludge.

New information suggests that facilities generating K086 may be phasing out the generation of these wastes. However, some facilities still report sporadic generation of K086. EPA believes that these wastes can be treated by certain BDAT technologies such as incineration for nonwastewaters; wet air oxidation, biological treatment, or steam stripping technologies for wastewaters; and technologies designed to treat metals. Because of the sporadic generation of K086 wastes, the characteristics of its listing criteria, and the known waste management practices for these wastes, EPA expects residues from the treatment of K086 to show similar analytical difficulties as those shown by U and P wastes. As a result, the Agency is promulgating, for the constituents candidate for regulation in K086 wastes (cyanides and organics), the same

treatment standards proposed for its U and P counterparts except for methanol- and cyclohexanone-containing nonwastewaters. The treatment standards promulgated for methanol and cyclohexanone nonwastewaters are methods of treatment.

For K086 wastewaters, the treatment standards for the U and P counterparts were developed and updated using treatment performance data for wastewaters from various sources: (1) the Office of Water's Industrial Technology Division (ITD) and National Pollution Discharge Elimination System (NPDES) data; (2) the Hazardous Waste Engineering Research Laboratory (WERL) data base; (3) the Office of Solid Waste's BDAT data from previous land disposal restrictions rules and the wastewater treatment test on wet air oxidation (WAO) and PACT$^{R}$ technologies; (4) industry-submitted leachate treatment performance data; and (5) additional wastewater treatment data from literature articles on WAO and PACT$^{R}$. (USEPA 1990a).

For K086 nonwastewaters, the treatment standards or methods of treatment are based on the U and P counterparts. Numerical treatment standards were developed for wastes that are amenable to quantification in hazardous waste matrices, and treatment standards specifying method of treatment were developed for wastes that are not amenable to quantification in hazardous waste matrices using current analytical methods.

The Agency has treatment performance data from two rotary kiln incinerator test burns EPA performed in June 1989 for waste constituents from several of the waste treatability groups. The Agency also has treatment performance data from 12 other incineration tests performed by EPA for previous rulemakings for the BDAT program (USEPA 1990b).

# 5. DETERMINATION OF BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

Data regarding characterization of K086 wastes and regarding ink formulation industry practices with regard to K086 treatment and disposal are reported earlier in this addendum and in the original background document. Conclusions drawn from analysis of the data are presented in the section entitled "Industries Affected and Waste Characterization." The Agency has obtained no new numerical treatment performance data.

Based on an examination of both old and new data, the Agency concludes that the best demonstrated available technology (BDAT) for all forms of K086 waste is the same as that for K086 solvent wash as contained in the background document for K086 solvent wash (USEPA 1988a). This conclusion is based on the similarities among the wastes as discussed in the Industries Affected and Waste Characterization section.

The Agency believes that K086 wastes generated by ink formulators would rarely meet the Agency's definition of wastewaters (less than 1 weight percent total suspended solids and less than 1 weight percent total organic carbon). Incineration of the as-generated K086 wastes would, however, result in wastewaters, e.g., incinerator scrubber waters, or incinerator ash that has been mixed with water for the purpose of reduction of hexavalent chromium ($Cr^{+6}$) to trivalent chromium ($Cr^{+3}$). Both of these wastewaters are considered K086 wastes by virtue of the Agency's "derived from" rule.

The BDAT for K086 wastes contained in the K086 solvent wash background document (USEPA 1988a) is summarized below by major K086 waste component.

| Major K086 Waste Component | BDAT |
|---|---|
| Nonwastewater organics and cyanide | Incineration |
| Metals | Hexavalent chromium reduction to trivalent chromium followed by lime precipitation and sludge filtration with stabilization of sludge |
| Wastewater Organics | Incineration, wet air oxidation or chemical oxidation followed by carbon adsorption, biological treatment, or steam stripping |

As shown, BDAT for organics and cyanide in K086 nonwastewaters is incineration. BDAT for organics in K086 wastewaters is incineration, wet air oxidation or chemical oxidation followed by carbon adsorption, biological treatment, or steam stripping (see Section 7). BDAT for chromium and lead in K086 is hexavalent chromium reduction followed by lime precipitation, sludge filtration, and stabilization of the sludge.

# 6. SELECTION OF REGULATED CONSTITUENTS

The Agency reviewed the list of regulated constituents for the K086 solvent wash in light of the additional data on waste characterization and industry practices. This review resulted in a revised list, which has been expanded by the addition of several constituents. The Agency believes that the revised list is appropriate for all forms of K086 waste.

The characterization data available for K086 wastes show a large number of hazardous constituents in K086 that could be candidates for regulation, possibly as a result of the widespread industry practice of reusing the same cleaning/ washing solutions to clean the equipment used for the formulation of many different ink batches (USEPA 1980, Versar 1989). Also, some of these hazardous constituents could be residues left in the ink formulation equipment that were originally ingredients or constituents in the feedstock materials used in the formulation of inks. Table 2-1 of this addendum lists all BDAT constituents detected in the K086 wastes characterized by the Agency. Any BDAT list constituent that is present above its detection limit is a candidate for regulation.

EPA is proposing to broaden the list of regulated constituents contained in the K086 solvent wash background document (USEPA 1988a) to account for constituents that are shown in Table 2-1 of this addendum but were not regulated in the First Third K086 solvent wash rulemaking. The constituents on the broadened list are acetophenone, butyl benzyl phthalate, di-n-butyl phthalate, and cyanide.

In addition, EPA proposes to regulate several other BDAT list constituents. These other constituents, which are listed in Table 6-1, are phthalate constituents. These additional phthalates are proposed for regulation either because they are reported as ink formulation ingredients (Flick 1985) or because they are BDAT list phthalates that

could be used as substitutes for the phthalates shown in Table 2-1. The phthalates--bis (2-ethylhexyl) phthalate, bucyl benzyl phthalate, and di-n-butyl phthalate--are shown in Table 2-1. The Agency is including the additional phthalates shown in Table 6-1 because the members of the regulated community can simply switch from regulated BDAT list phthalates to nonregulated BDAT list phthalates in order to avoid regulation. This approach is consistent with the Agency's determinations for the solvent standards already promulgated in the First Third Final Rule (53 FR 31138).

Table 6-1 Additional Constituents for Regulation of K086

| BDAT reference number | Constituent |
|---|---|
| 92 | Diethyl phthalate |
| 97 | Dimethyl phthalate |
| 104 | Di-n-octyl phthalate |

The Agency believes that treatment of regulated BDAT constituents to levels given in this addendum will result in essentially complete removal or destruction of unregulated BDAT list constituents.

The Agency considered adding additional metals to lead and chromium, which were regulated for K086 solvent wash. For example, both barium and cadmium were considered for addition. However, the Agency decided not to add additional metals for this rulemaking because the Agency believes regulation of chromium and lead will provide for regulation of barium and cadmium, as well as other BDAT metals that may be present in K086 wastes. Those processes used to reduce lead and chromium concentrations in the K086 treatment residual leachate to below the treatment standards are also known to reduce concentrations of other metals in the K086 treatment residual leachate (see data in Table 4-2 of the K086 solvent wash background document (USEPA 1988a)).

# 7. CALCULATION OF BDAT TREATMENT STANDARDS

The explanation of the calculation of the treatment standards is given below on a constituent-by-constituent basis, in approximately the same order as that in Table 1-1.

The Agency points out that many of the treatment standards for individual regulated constituents are now different from the treatment standards set for K086 solvent wash in the First Third rulemaking, particularly regarding organic constituents. This is because of the Agency's belief that treatment, particularly incineration, of K086 wastes is often done with other hazardous and nonhazardous wastes (i.e., co-incineration). The mixing of K086 wastes with other solvents as well as other hazardous/nonhazardous wastes prior to incineration may result in treatment residuals (incinerator ashes and scrubber waters) that could vary in composition, possibly affecting detection limits for the regulated organic constituents.

Several commenters to the First Third Rule expressed the above concern regarding achieving K086 solvent wash standards. Thus, the Agency has reviewed additional incineration data and is revising some of the standards for K086 solvent wash in order to address the issue.

With regard to the co-incineration issue, the Agency believes that treatment of K086 is similar to the offsite treatment of P and U wastes. That is, P and U wastes that are not treated at the site where they are generated are shipped to commercial treatment facilities where the P and U wastes are treated along with other wastes. Since both K086 wastes and P and U wastes are likely to be commingled with other wastes for treatment by incineration, the Agency believes it is appropriate that organic constituents of K086 have the same treatment standards as their P and U counterparts.

In conjunction with this and prior rulemakings, the Agency has examined numerous sets of data for incineration of wastes containing organic constituents that are the same as or similar to the organic constituents found in K086 wastes. Based on these examinations, the Agency believes that well-designed, well-operated incinerators are capable of destroying organics in K086 waste to concentrations well below the standards being proposed for K086 organic constituents, regardless of whether the K086 wastes are mixed with other hazardous or nonhazardous wastes.

Wastewater treatment data primarily from EPA's Office of Water have been analyzed for the development of concentration-based treatment standards for many of the U and P wastes. These data include the treatment of wastewaters that are not specifically listed as U or P wastewaters, but do contain many of the corresponding U or P constituents.

## 7.1 Volatile Organics

### 7.1.1 Acetone

For nonwastewaters, the Agency has examined data from 14 incineration burns. This examination was conducted in conjunction with the Third Third rulemaking for U002. Acetone was detected in three of the incineration tests. The highest detection limit in the test in which it was detected in the untreated waste was 0.01 ppm. The Agency believes that this detection limit is too low to be routinely achievable in ash by analytical laboratories. The highest detection limit for acetone from all the incineration tests was used to calculate a treatment standard of 160 mg/kg acetone for U002. This standard is transferred to acetone in K086 nonwastewaters and is presented in Table 7-1.

In contrast, the acetone standard for K086 solvent wash nonwastewater in the First Third rulemaking was determined based on the acetone

Table 7-1a BDAT Treatment Standards for
K086 Volatile Organic Constituents

| Constituent | Maximum (single grab sample) | |
|---|---|---|
| | Nonwastewater Total concentration (mg/kg) | Wastewater Total concentration (mg/l) |
| Acetone | 160 | 0.28 |
| n-Butyl alcohol | 2.6 | 5.6 |
| Methyl ethyl ketone | 36 | 0.28 |
| Methyl isobutyl ketone | 36 | 0.14 |

Table 7-1b BDAT Treatment Standards for
K086 Volatile Organic Constituents

| Constituent | Maximum (composite samples) Nonwastewater Total concentration (mg/kg) | Maximum (composite samples) Wastewater Total concentration (mg/l) |
|---|---|---|
| Ethyl acetate | 33 | 0.34 |
| Ethylbenzene | 6.0 | 0.057 |
| Methanol | [a] | 5.6 |
| Methylene chloride | 33 | 0.089 |
| Toluene | 28 | 0.080 |
| 1,1,1-Trichloroethane | 5.6 | 0.054 |
| Trichloroethylene | 5.6 | 0.054 |
| Xylene (total) | 28 | 0.32 |

[a] At this time, EPA is withdrawing this constituent from the list of regulated constituents in K086 nonwastewaters (see Section 7.1.6 for a discussion of this decision).

detection limit in a filter cake resulting from the filtration of a metal-bearing wastewater that had been treated to precipitate metals. This resulted in a standard of 0.37 mg/l acetone. The Agency notes that today's promulgated standard for acetone is based on acetone detection limits in incinerator ash. Because incineration processes destroy acetone, and the resulting matrices reflect the treatment of K086 wastes that yield ash, the Agency believes this new standard is more realistic than the one previously promulgated for K086 solvent washes.

The data available for wastewaters containing acetone were compiled from the WERL and NPDES data bases and wet air oxidation (WAO) data and are presented in the Appendix A. The promulgated BDAT standard was set using biological treatment technology and an achievable effluent of 100 ppb. When leachate treatment performance data are submitted, showing substantial treatment for a constituent that shows average leachate effluent values greater than those used in setting the treatment standard, the leachate treatment performance data are given priority and used as BDAT.

The resulting BDAT treatment standard for acetone-containing wastewaters is 0.28 ppm as shown in Table 7-1.

### 7.1.2 n-Butyl Alcohol

The Agency believes that nonwastewaters containing n-butanol would be essentially completely destroyed in a well-designed, well-operated incinerator and that analyses of incinerator ash and scrubber waters would show nondetectable concentrations of n-butanol. Thus, performance data from well-designed and well-operated incinerators would always show nondetectable concentrations of n-butanol in the incinerator residuals.

In conjunction with setting treatment standards for n-butanol in U031, the Agency examined detection limits for n-butanol in incinerator ash and incinerator scrubber water. In many cases there were no attempts made to analyze for n-butanol and therefore no detection limit data were available. However, the Agency did find detection limit data for analysis of incinerator residuals from one incinerator. These limits were 0.4 mg/kg and 0.2 mg/l for n-butanol in the ash and scrubber water, respectively. The Agency used an accuracy correction factor of 2.33 and a variability factor of 2.8 to calculate a treatment standard for n-butanol of 2.6 in U031 nonwastewaters (see Table 7-1).

For wastewaters containing n-butyl alcohol, data were compiled from the Hazardous Waste Engineering Research Laboratory (WERL) data base and are presented in Appendix A. The promulgated BDAT standard was set using biological treatment and an achievable effluent of 2000 ppb. The resulting treatment standard for wastewaters containing n-butyl alcohol is 5.6 ppm as shown in Table 7-1.

### 7.1.3 Ethyl Acetate

The standard for nonwastewaters containing ethyl acetate was revised to reflect detection levels in different wastes because the matrices used to generate the proposed standards were ash from burns of phthalate wastes (K024) and disulfoton wastes (K037), both unique matrices. Acetone and ethyl acetate are volatile organics while K024 and K037 raw wastes, from which proposed standards for these compounds were derived, are high in semivolatile compounds such as PNAs. EPA chose to base the promulgated standards on a matrix from incinerated wood-preserving wastes (K001 PCP and creosote) because these are complex matrices with high concentrations of many organic compounds, volatiles, semivolatiles, chlorinateds, and others, and, consequently, are particularly difficult to analyze. Detection limit from these compounds are thus particularly

achievable. Therefore, the Agency is revising the nonwastewater standard for ethyl acetate to 29 mg/kg as shown in Table 7-1.

For wastewaters containing ethyl acetate, data were compiled from the WERL data base and the EPA WAO test. These data are presented in Appendix A. Biological treatment (e.g., activated sludge) has been selected as BDAT because the data show a high influent concentration and high removal efficiency. The treatment standard for wastewaters containing ethyl acetate is 0.34 ppm as shown in Table 7-1.

### 7.1.4 Ethylbenzene

The Agency is revising the nonwastewater standard for ethylbenzene based on treatment performance data for K019. Detailed information on the treatment performance data and methodology used to calculate the treatment standards can be found in the K019 background document. Therefore, for ethylbenzene nonwastewaters, the treatment standard is 6.0 mg/l and is shown in Table 7-1.

For wastewaters containing ethylbenzene, data were compiled from the WERL data base, BDAT Solvents Rule data, and literature PACT® AND WAO data. These data are presented in Appendix A. The promulgated BDAT standard was set using biological treatment and an achievable effluent of 10 ppb. The BDAT treatment standard for ethylbenzene-containing wastewaters is 0.057 ppm as shown in Table 7-1.

### 7.1.5 Toluene and Xylene (total)

In conjunction with the rulemaking for aromatic hydrocarbon U-wastes, the Agency is transferring treatment standards for toluene (U220) and total xylene (U239) to K086 wastes (USEPA 1989e).

For U220 and U239 nonwastewaters, the standards are 28 mg/kg toluene and 28 mg/kg total xylene. Detailed information on the treatment performance data and methodology used to calculate the treatment standards can be found in the U220 (toluene) and U239 (total xylene) background documents.

For wastewaters containing toluene, data were available from the ITD and WERL data bases, BDAT Solvents Rule data, literature WAO and PACT® data, and EPA WAO test data. The BDAT for toluene is steam stripping, and the treatment standard is 0.08 mg/l. For wastewaters containing xylene, data were available from the NPDES and WERL data bases, BDAT Solvents Rule data, and literature WAO and PACT® data. The BDAT for wastewaters containing xylene is wet air oxidation, and the treatment standard is 0.32 mg/l.

The treatment standards presented above can be found in Table 7-1.

### 7.1.6 Methanol

For nonwastewaters containing methanol, a method of treatment for nonwastewaters containing methanol is being specified as the treatment standard because of complications encountered in applying the treatment standard calculation methodology for U and P wastes to the data available for a particular waste.

Treatment standards for U and P wastes that are amenable to quantification in hazardous waste matrices were calculated based on detection limits for incinerator ash and scrubber water residuals collected during the 14 BDAT incineration treatment tests performed by EPA for the BDAT Land Disposal Restrictions Program. Concentration-based treatment standards were calculated by multiplying the constituent detection limit by an accuracy correction factor and by a variability factor. The range of detection limits spanned several orders of

magnitude, suggesting the presence of matrix interferences in the treatment residuals. The treatment standards that were then calculated were 1,000 ppm or greater. The establishment of treatment standards at these levels would not ensure substantial treatment for the constituents of concern. Therefore, for nonwastewaters containing methanol, the Agency is specifying a method of treatment consisting of incineration, wet air oxidation followed by chemical adsorption, or chemical oxidation followed by chemical adsorption. The carbon is then incinerated and must meet the nonwastewater standard.

For wastewaters containing methanol, data were compiled from the WERL data base and literature PACT® data and are presented in Appendix A. The promulgated BDAT standard was set using biological treatment and an achievable effluent of 2,000 ppb. When leachate treatment performance data were submitted showing substantial treatment for a constituent that showed average leachate effluent values greater than those used in setting the proposed standard, the leachate treatment performance data were given priority and used as BDAT. Therefore, for methanol in wastewater forms of multisource leachate, the treatment standard is 5.6 mg/l as shown in Table 7-1.

### 7.1.7 Methyl Ethyl Ketone and Methyl Isobutyl Ketone

In conjunction with the rulemaking for U159 (methyl ethyl ketone) and U161 (methyl isobutyl ketone), the Agency examined results of incinerating several different wastes containing these constituents in several different incinerators (USEPA 1989d). The constituents were not detected in incinerator ash or scrubber water in all cases except one case where the blank was contaminated with methyl ethyl ketone.

The Agency is transferring the resultant standard of 33 mg/kg for methyl isobutyl ketone in U161 nonwastewater to methyl isobutyl ketone in K086 nonwastewater. The Agency is transferring the treatment standards

for methyl ethyl ketone in U159 nonwastewater to methyl ethyl ketone in K086 nonwastewater. The treatment standards for nonwastewaters containing methyl ethyl ketone and methyl isobutyl ketone are 36 mg/kg and 33 mg/kg, respectively. These standards are presented in Table 7-1. Detailed information on the treatment performance data and methodology used to calculate the treatment standards can be found in the U159 (methyl ethyl ketone) and U161 (methyl isobutyl ketone) background documents.

The data available for methyl ethyl ketone-containing wastewaters were compiled from the NPDES data base, WERL data base, literature PACT® and WAO data, and EPA WAO test data. These data are presented in Appendix A. The promulgated BDAT standard was set using biological treatment and an achievable effluent of 50 ppb. The treatment standard for methyl ethyl ketone-containing wastewaters is 0.28 mg/l. The data available for methyl isobutyl ketone-containing wastewaters were compiled from the WERL and NPDES data bases, BDAT Solvent Rule data, and EPA WAO test data. The promulgated BDAT standard was set using biological treatment and an achievable effluent of 50 ppb. The treatment standard for methyl isobutyl ketone wastewaters is 0.14 mg/l as shown in Table 7-1.

For promulgated wastewater standards for both methyl ethyl ketone and methyl isobutyl ketone, the leachate treatment performance data were given priority and used as BDAT because they showed substantial treatment for a constituent that showed average leachate effluent values greater than those used in setting the proposed standards.

### 7.1.8 Methylene Chloride, 1,1,1-Trichloroethane, and Trichloroethylene

The Agency is proposing treatment standards for methylene chloride, 1,1,1-trichloroethane, and trichloroethylene in U080, U226, and U228 in conjunction with the regulation of halogenated aliphatic U-wastes (USEPA 1989f).

The treatment standards for nonwastewaters containing methylene chloride, 1,1,1-trichloroethane, and trichloroethylene are based on examination of performance data and detection limits of many incinerator ashes and scrubber waters resulting from treatment of wastes containing halogenated aliphatics. The Agency is transferring the standards for U080, U226, and U228 to K086. Thus for K086 nonwastewaters, the proposed standards are 33 mg/kg, 5.6 mg/kg, and 5.6 mg/kg for methylene chloride, 1,1,1-trichloroethane, and trichloroethylene, respectively. These standards are presented in Table 7-1.

Although methylene chloride is a common laboratory contaminant at very low levels, the Agency believes that good laboratory practices can reduce the presence of methylene chloride to a few parts per billion in the blank. The Agency has also reviewed its own data for the 14 incinerator burns and believes that a laboratory can achieve good recovery for this constituent. Therefore, the Agency is promulgating a concentration-based standard of 33 mg/kg. This standard was revised when EPA reevaluated the recovery factor used to calculate the standard. The proposed standard was based on an average recovery factor from several of the spiked constituents, whereas the revised standard is based on the recovery factor from a single constituent.

For wastewaters containing methylene chloride, 1,1,1-trichloroethane, and trichloroethylene, data available included the ITD and WERL data bases, BDAT Solvents Rule data, and literature WAO and PACT® data. The treatment performance data available from the ITD data base were used for setting the promulgated treatment standards for these three constituents. The BDAT for all three constituents is steam stripping. The treatment standards for wastewater forms of methylene chloride, 1,1,1-trichloroethane, and trichloroethylene are presented in Table 7-1. For K086 wastewaters, the treatment standards are 0.089 mg/l, 0.054 mg/l, and 0.054 mg/l for methylene chloride, 1,1,1-trichloroethane, and trichloroethylene, respectively.

## 7.2 Semivolatile Organics

The Agency is proposing to regulate the following semivolatile organics in K086 treatment residuals:

Acetophenone
Bis(2-ethylhexyl)phthalate
Butyl benzyl phthalate
Cyclohexanone
1,2-Dichlorobenzene
Diethylphthalate
Dimethylphthalate
Di-n-butylphthalate
Di-n-octylphthalate
Naphthalene
Nitrobenzene

Acetophenone (U004) is being regulated as part of the oxygenated hydrocarbon treatability group (USEPA 1989d). The Agency is transferring the standard for U004 to this K086 constituent. Additional detection limit data received presented detection limits for acetophenone that were 1.4 to 8.6 mg/kg for five laboratories and 15.9 mg/kg for one laboratory. The detection limits for EPA's data ranged from 0.19 to 2.0 mg/kg. Therefore, EPA believes that laboratories can analyze this constituent at levels below the revised nonwastewater treatment standard of 9.7 mg/kg. This standard was revised when EPA reevaluated the recovery factor used to calculate the standard. The proposed standard was based on an average recovery factor from several of the spiked constituents, whereas the revised standard is based on the recovery factor from a single constituent. Thus the treatment standard for this K086 nonwastewater is 9.7 mg/kg acetophenone as shown in Table 7-2.

The data available for wastewaters containing acetophenone were compiled from the NPDES database and leachate treatment performance data and are presented in Appendix A. The promulgated BDAT standard was set using biological treatment and an achievable effluent of 2.9 ppb. The treatment standard for K086 wastewaters containing acetophenone is 0.010 mg/l as shown in Table 7-2.

Phthalate U-wastes were regulated as part of the Agency's Second Third rulemaking. Background data and explanations for the phthalate treatment standards were contained in the background document for phthalate waste (USEPA 1989g). The Agency proposes to transfer the standards for the phthalate U-wastes to the regulated phthalates in K086. The U- or K- waste counterparts to each phthalate are bis(2-ethylhexyl)phthalate (U028), butylbenzyl phthalate (K019), diethyl phthalate (U088), dimethyl phthalate (U102), di-n-butyl phthalate (U069), and di-n-octyl phthalate (U107). Thus the promulgated standards for bis(2-ethylhexyl)phthalate, diethyl phthalate, dimethyl phthalate, di-n-butyl phthalate, and di-n-octyl phalate are 28 mg/kg in K086 nonwastewaters and are presented in Table 7-2. The promulgated treatment standard for butylbenzylphthalate is 7.9 mg/l as shown in Table 7-2. Detailed information on the treatment performance data and methodology used to calculate the treatment standards can be found in the respective U- or K- waste background documents.

For wastewaters containing phthalate U-wastes, three sources of wastewater treatment performance data were available for bis(2-ethylhexyl)phthalate, diethyl phthalate, dimethyl phthalate, di-n-butyl phthalate, and di-n-octyl phthalate. These are the ITD and WERL data bases and literature WAO and PACT® data presented in Appendix A. The ITD data were used for setting the BDAT standards presented in Table 7-2. The BDAT for these constituents is biological treatment.

For wastewaters containing butyl benzyl phthalate, data were compiled from the NPDES and WERL data bases and literature PACT® data. These data are presented in Appendix A. The promulgated BDAT standard was set using biological treatment (e.g., activated sludge) and an achievable effluent of 3 ppb. The treatment standard for wastewaters containing butyl benzyl phthalate is 0.017 mg/l as shown in Table 7-2.

Table 7-2 BDAT Treatment Standards for
K086 Semivolatile Organic Constituents

| Constituent | Maximum (single grab samples) | |
|---|---|---|
| | Nonwastewater Total concentration (mg/kg) | Wastewater Total concentration (mg/l) |
| Acetophenone | 9.7 | 0.10 |
| Cyclohexanone | [a] | 0.36 |
| 1,2-Dichlorobenzene | 6.2 | 0.088 |

[a] At this time, EPA is withdrawing this constituent from the list of regulated constituents in K086 nonwastewaters.

| Constituent | Maximum (composite samples) | |
|---|---|---|
| | Nonwastewater Total concentration (mg/kg) | Wastewater Total concentration (mg/l) |
| Bis(2-ethylhexyl)phthalate | 28 | 0.28 |
| Butylbenzylphthalate | 7.9 | 0.017 |
| Diethyl phthalate | 28 | 0.20 |
| Dimethyl phthalate | 28 | 0.047 |
| Di-n-butyl phthalate | 28 | 0.057 |
| Di-n-octyl phthalate | 28 | 0.017 |
| Naphthalene | 3.1 | 0.059 |
| Nitrobenzene | 14 | 0.068 |

For nonwastewaters containing cyclohexanone, the Agency has determined that a concentration-based treatment standard cannot be supported for this constituent. Data submitted by a commenter representing the hazardous waste treatment industry for nonwastewater forms of cyclohexanone reported such drastic detection limit discrepancies or extreme recoveries that EPA believes these analytes belong in the category of those constituents not amenable to quantification. Therefore, the Agency is promulgating a treatment standard based on a method of treatment. This method of treatment is incineration.

For wastewaters containing cyclohexanone, no treatment performance data were available from any of the examined sources. Treatment performance data were therefore transferred to this constituent from methyl ethyl ketone. The data are presented in Appendix A. Using a transfer from this constituent results in a BDAT of biological treatment and a wastewater treatment standard of 0.36 mg/l as shown in Table 7-2.

In conjunction with the proposed rulemaking for Third Third wastes, the Agency is proposing standards for 1,2-dichlorobenzene-, napthalene-, and nitrobenzene-containing U-wastes (U020, U165, and U169, respectively). Documentation for the treatment standards for these wastes can be found in their respective background documents (USEPA 1989h, USEPA 1989i, USEPA 1989j). The Agency proposes to transfer the standards for U020, U165, and U169 to K086 wastes. Thus the proposed treatment standards for K086 nonwastewaters are 6.2 mg/kg, 1,2-dichlorobenzene, 3.1 mg/kg naphthalene, and 14 mg/kg nitrobenzene. For naphthalene-containing nonwastewaters, EPA reevaluated the data supporting this constituent. The detection limits ranged from 0.11 to 2 mg/kg. Additional data presented detection limits ranging from 0.18 to 0.34 for five laboratories and 5.7 for a sixth laboratory. Based on these data, the Agency believes that detection limits below 3 mg/kg are achievable. Therefore, the Agency is promulgating a standard of

3.1 mg/kg for nonwastewaters containing naphthalene. This standard is based on the data from the incineration of K019. Treatment standards for the constituents listed above are presented in Table 7-2.

For wastewaters containing 1,2-dichlorobenzene, the data available were compiled from the WERL data base, BDAT Solvents Rule data, and literature WAO data. These data are presented in Appendix A. The promulgated treatment standard was set using biological treatment and an achievable effluent of 16 ppb. The wastewater treatment standard for 1,2-dichlorobenzene is 0.088 mg/l as shown in Table 7-2.

For wastewaters containing naphthalene, data were compiled from the ITD and WERL data bases as well as literature from WAO data. These data are presented in Appendix A. The BDAT for naphthalene wastewaters is biological treatment, and the treatment standard is 0.059 mg/l as shown in Table 7-2.

For wastewaters containing nitrobenzene, data were compiled from the ITD, BDAT, and WERL data bases, BDAT Solvents Rule data, and literature WAO data and are presented in Appendix A. The BDAT for this constituent is steam stripping followed by activated carbon. The treatment standard for wastewaters containing nitrobenzene is 0.068 mg/l and is shown in Table 7-2.

## 7.3 Metals

The Agency believes that the standards for metals given in the K086 solvent wash background document are applicable to all forms of K086 wastes. The Agency recognizes that as-generated K086 wastes may have different compositions (see Table 2-1). Consequently, different as-generated K086 wastes may require different pretreatment steps prior to application of chromium reduction/lime precipitation/stabilization steps. Suitable pretreatment, e.g., by incineration to destroy organics

and cyanide, would lead to feeds to the chromium reduction/lime precipitation/stabilization steps that are similar with respect to chromium and lead, regardless of the initial compositions of the as-generated K086 wastes. Thus, the Agency is retaining the K086 solvent wash metals standards and making them applicable to all forms of K086 wastes. For nonwastewaters, the standards are 0.094 mg/l chromium and 0.37 mg/l lead in the TCLP leachate; for wastewaters the standards are 0.32 mg/l chromium and 0.037 mg/l lead. The treatment standards presented above are presented in Table 7-3.

## 7.4 Cyanide

For cyanide in K086, the Agency is proposing standards based on previously promulgated standards for F010 (USEPA 1989k). These standards are 1.5 mg/kg cyanide for nonwastewaters and 1.9 mg/l cyanide for wastewaters; the standards are presented in Table 7-3.

Table 7-3 BDAT Treatment Standards for K086 Metals and Cyanide

| Constituent | Nonwastewater Total concentration (mg/kg) | Nonwastewater TCLP (mg/l) | Wastewater Total concentration (mg/l) |
|---|---|---|---|
| Chromium (total) | N/A | 0.094 | 0.32 |
| Lead | N/A | 0.37 | 0.037 |
| Cyanide | 1.5 | N/A | 1.9 |

# 8. REFERENCES

References for this addendum are as follows:


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USEPA. 1989b. U.S. Environmental Protection Agency. Best demonstrated available technology (BDAT) background document for methodology. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1989c. U.S. Environmental Protection Agency. Draft K086 characterization report for Croda Inks Corporation, St. Louis, Missouri. Cincinnati, Ohio: U.S. Environmental Protection Agency.

USEPA. 1989d. U.S. Environmental Protection Agency. Proposed best demonstrated available technology (BDAT) background document for oxygenated functional groups and oxygenated heterocyclic U and P wastes. Washington, D.C., U.S. Environmental Protection Agency.

USEPA. 1989e. U.S. Environmental Protection Agency. Proposed best demonstrated available technology (BDAT) background document for non-halogenated aromatic U-wastes. Washington, D.C. U.S. Environmental Protection Agency.

USEPA. 1989f. U.S. Environmental Protection Agency. Proposed best demonstrated available technology (BDAT) background document for halogenated aliphatic U-wastes. Washington, D.C. U.S. Environmental Protection Agency.

USEPA. 1989g. U.S. Environmental Protection Agency. Final best demonstrated available technology (BDAT) background document for phthalate wastes. Washington, D.C. U.S. Environmental Protection Agency.

USEPA. 1989h. U.S. Environmental Protection Agency. Proposed best demonstrated available technology (BDAT) background document for chlorobenzenes and other wastes. Washington, D.C. U.S. Environmental Protection Agency.

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USEPA. 1989j. U.S. Environmental Protection Agency. Proposed best demonstrated available technology (BDAT) background document for nitrogen-containing organic wastes. Washington, D.C. U.S. Environmental Protection Agency.

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Versar. 1988c. K086 washwater composition data. Memorandum dated February 5, 1988, from S. Schwartz (Versar) to J. Labiosa (EPA).

Versar. 1988d. Waste characterization data for K086 wastewaters. Memorandum dated February 3, 1988, from P. Redmond (Versar) to J. Labiosa (EPA).

Versar. 1989. File memos dated May 8, 1989, documenting telephone conversations with approximately 35 ink formulators.

# APPENDIX A

WASTEWATER TREATMENT PERFORMANCE DATA
FOR ACETONE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| | | NY0084859 | | | 8 | 126.000 | | | NPDES |
| | | NH0001376 | | | 10 | 620.560 | | | NPDES |
| | | MA0000442 | | | 10 | 808.000 | | | NPDES |
| | | NY0107760 | | | 14 | 296.429 | | | NPDES |
| | | CT0001341 | | | 23 | 420.000 | | | NPDES |
| | | AZ0000108 | | | 11 | 0.846 | | | NPDES |
| | | AZ0000108 | | | 11 | 1.000 | | | NPDES |
| | | AZ0000108 | | | 11 | 1.000 | | | NPDES |
| | | MA0000442 | | | 4 | 31.000 | | | NPDES |
| | | NY0081698 | | | 8 | 804.965 | | | NPDES |
| | | NY0107484 | | | 16 | 1010.780 | | | NPDES |
| AS | Pilot | 241B | | 1000-10000 | 5 | 28.000 | | 98.5 | WERL |
| AS | Full | 1168E | | 10000-100000 | | 1100.000 | | 97.1 | WERL |
| * GAC | Full | 245B | | 1000-10000 | 1 | 50.000 | | 95.9 | WERL * |
| PACT | Bench | 242E | | 100-1000 | | 20.000 | | 91.4 | WERL |
| PACT | Bench | Zimpro | | 233 | 1 | 20.000 | | 91 | WAO |
| RO | Full | 250B | | 1000-10000 | | 200.000 | | 81 | WERL |
| RO | Full | 250B | | 10000-100000 | | 5800.000 | | 78 | WERL |
| SS | Pilot | 1082E | | 10000-100000 | | 10000.000 | | 80 | WERL |
| WOx | Full | 242E | | 1000000 | | 230.000 | | 99.99 | WERL |
| WOx (B) | Bench | 78D | | 1000000 | | 10000.000 | | 99.4 | WERL |

INDUSTRY SUBMITTED LEACHATE TREATMENT
PERFORMANCE DATA FOR ACETONE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| BT | | CWM | 100 | 1900-10000 | 3 | 100 | | 97.92 | LEACHATE |
| BT | B | CWM | 100 | 9133 | 3 | 100 | | 98.91 | LEACHATE |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR n-BUTYL ALCOHOL

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| * AS | Full | 1168E | | 10000-100000 | | 40.000 | | 99.79 | WERL * |

TABLE 4-8B
INDUSTRY SUBMITTED LEACHATE TREATMENT PERFORMANCE
DATA FOR n-BUTYL ALCOHOL

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| BT | | CMM | 2000 | 2800 | 1 | 2000 | | 28.57 | LEACHATE |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR ETHYL ACETATE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| * AS<br>WOx | Bench<br>Pilot | 2020<br>Zimpr | 130 | 1000-10000<br>630000-770000 | 3 | 60.000<br>580.000 | | 96.4 | WERL *<br>WAO |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR ETHYL BENZENE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AL | Pilot | 203A | | 100-1000 | 14 | 12.000 | | 89 | WERL |
| AL | Pilot | 203A | | 100-1000 | 14 | 27.000 | | 76 | WERL |
| AL | Full | 1B | | 0-100 | 4 | 10.000 | | 69 | WERL |
| AL+AS | Full | 233D | | 1000-10000 | 21 | 4.000 | | 99.93 | WERL |
| API+DAF+AS | Full | 1482D | | 100000-100000 | 4 | 3.300 | | 99.98 | WERL |
| AS | Bench | 200B | | 100-1000 | 6 | 0.700 | | 99.89 | WERL |
| AS | Full | 201B | | 0-100 | 16 | 6.000 | | 92.8 | WERL |
| AS | Pilot | 206B | | 0-100 | 20 | 0.200 | | 99.76 | WERL |
| AS | Full | 6B | | 100-1000 | 3 | 10.000 | | 98.2 | WERL |
| AS | Full | 238A | | 0-100 | 3 | 0.500 | | 97.2 | WERL |
| AS | Pilot | 240A | | 0-100 | 14 | 1.000 | | 98.4 | WERL |
| AS | Full | 6B | | 100-1000 | 24 | 10.000 | | 94.4 | WERL |
| AS | Full | 234A | | 0-100 | | 0.200 | | 99.14 | WERL |
| AS | Full | 234A | | 0-100 | | 0.200 | | 99.22 | WERL |
| AS | Bench | 202D | | 10000-100000 | | 80.000 | | 99.87 | WERL |
| AS | Full | 6B | | 1000-10000 | 4 | 10.000 | | 99.47 | WERL |
| AS | Full | 975B | | 1000-10000 | | 8.000 | | 99.8 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 9.000 | | 90.7 | WERL |
| AS | Full | 975B | | 100-1000 | | 10.000 | | 96.4 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 3.000 | | 89 | WERL |
| AS | Pilot | 241B | | 100-1000 | 5 | 5.000 | | 97.6 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 5.000 | | 89 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 1.000 | | 98.1 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 1.000 | | 97.7 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 5.000 | | 79 | WERL |
| AS | Full | 6B | | 1000-10000 | 3 | 25.000 | | 98.7 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 3.000 | | 95.4 | WERL |
| AS | Full | 975B | | 0-100 | | 8.000 | | 87 | WERL |
| AS | Pilot | 203A | | 100-1000 | 14 | 6.000 | | 94.6 | WERL |
| AS | Pilot | REF2 | | 23500 | 6 | 366.000 | | | BDAT # |
| AS | Full | 1B | | 100-1000 | 6 | 4.000 | | 97.5 | WERL |
| AS | Full | 1B | | 100-1000 | 3 | 2.000 | | 99.26 | WERL |
| AS | Full | 1B | | 100-1000 | 4 | 1.000 | | 99.17 | WERL |
| AS | Bench | 200B | | 0-100 | 9 | 0.500 | | 99.5 | WERL |
| AS | Full | 6B | | 100-1000 | 7 | 10.000 | | 97.9 | WERL |
| AS | Full | 6B | | 100-1000 | 15 | 10.000 | | 98.9 | WERL |
| AS | Full | 6B | | 100-1000 | 29 | 10.000 | | 97.4 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 8.000 | | 89 | WERL |
| AS | Full | 6B | | 10000-100000 | 7 | 10.000 | | 99.97 | WERL |
| AS | Bench | 200B | | 100-1000 | 12 | 0.600 | | 99.5 | WERL |

# ITD Data presented in the BDAT Solvents Rule F001-F005 Background Document.

WASTEWATER TREATMENT PERFORMANCE DATA
FOR ETHYL BENZENE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AS+Fil | Full | 6B | | 0-100 | 15 | 10.000 | | 90 | WERL |
| AirS | Pilot | 224B | | 0-100 | 1 | 0.500 | | 91.9 | WERL |
| AirS | Full | 69A | | 0-100 | | 0.300 | | 94.1 | WERL |
| AirS+GAC | Full | 229A | | 0-100 | 19 | 1.000 | | 80 | WERL |
| * BT | Full | P211 | | 12923-80000 | 7 | 10.000 | | | BDAT # * |
| * BT | Full | P234 | | 10-3850 | 33 | 10.000 | | | BDAT # * |
| * BT | Full | P221 | | 10-140 | 3 | 10.000 | | | BDAT # * |
| * BT | Full | P293 | | 2287-3565 | 2 | 10.000 | | | BDAT # * |
| * BT | Full | P238 | | 220-3350 | 2 | 10.000 | | | BDAT # * |
| * BT | Full | P215 | | 564-4150 | 3 | 10.000 | | | BDAT # * |
| * BT | Full | P242 | | 190-553 | 2 | 10.000 | | | BDAT # * |
| * BT | Full | P244 | | 608 | 1 | 10.000 | | | BDAT # * |
| * BT | Full | P257 | | 63-3648 | 27 | 12.000 | | | BDAT # |
| * BT | Full | P202 | | 96-596 | 20 | 10.000 | | | BDAT # * |
| * BT | Full | P230 | | 101-3040 | 15 | 10.000 | | | BDAT # * |
| * BT | Full | P299 | | 22-230 | 16 | 10.000 | | | BDAT # * |
| * BT | Full | P251 | | 1235-1360 | 3 | 10.000 | | | BDAT # * |
| * BT | Full | P253 | | 10-144 | 2 | 10.000 | | | BDAT # * |
| CAC | Pilot | 203A | | 100-1000 | 14 | 73.000 | | 34 | WERL |
| GAC | Full | 1421D | | 0-100 | | 0.100 | | 37 | WERL |
| PACT | Bench | 242E | | 0-100 | | 5.000 | | 76 | WERL |
| PACT | Bench | Zimpro | | 185 | 1 | 1.000 | | 99.5 | WAO |
| PACT | Bench | 200B | | 0-100 | 11 | 0.400 | | 99.57 | WERL |
| PACT | Bench | Zimpro | | 21 | 1 | 5.000 | | 76 | WAO |
| RO | Pilot | 180A | | 0-100 | | 0.020 | | 71 | WERL |
| RO | Pilot | 250B | | 0-100 | | 5.000 | | 92.9 | WERL |
| RO | Full | 250B | | 1000-10000 | | 170.000 | | 97 | WERL |
| SS | Pilot | REF2 | | 23500 | 5 | 206.000 | | | BDAT |
| TF | Pilot | 240A | | 0-100 | 14 | 1.000 | | 98.4 | WERL |
| TF | Pilot | 203A | | 100-1000 | 14 | 31.000 | | 72 | WERL |
| TF | Full | 1B | | 100-1000 | 4 | 11.000 | | 90.8 | WERL |
| TF | Full | 1B | | 0-100 | 4 | 4.000 | | 90.9 | WERL |
| UF | Pilot | 250B | | 100-1000 | | 70.000 | | 59 | WERL |
| WOx | Full | Zimpro | 50 | 19000-27000 | 2 | 3550.000 | | | WAO |
| WOx | Full | 242E | | 1000-10000 | | 21.000 | | 99.65 | WERL |
| WOx [B] | Bench | 1054E | | 1000-10000 | | 500.000 | | 94.6 | WERL |
| WOx [B] | Bench | 1054E | | 100000-1000000 | | 30000.000 | | 97 | WERL |

# ITD data presented in the BDAT Solvents Rule F001-F005 Background Document.

WASTEWATER TREATMENT PERFORMANCE DATA
FOR METHANOL

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| * PACT | Bench | Zimpro | | 208000 | 1 | 10.000 | | 99.99 | WAO * |
| SS | Pilot | 1082E | | 1000000 | | 230000.000 | | 84 | WERL |
| WOx | Full | 242E | | 1000000 | | 210000.000 | | 89.6 | WERL |
| WOx | Bench | 78D | | 1000000 | | 290000.000 | | 91 | WERL |

INDUSTRY SUBMITTED LEACHATE TREATMENT PERFORMANCE
DATA FOR METHANOL

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| BT | | CHM | 2000 | 7600-31000 | 3 | 2000.000 | | 87.23 | LEACHATE |

TABLE 4-32A
WASTEWATER TREATMENT PERFORMANCE DATA
FOR METHYL ETHYL KETONE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| | | NY0096792 | | | 8 | 3.400 | | | NPDES |
| | | NY0072231 | | | 10 | 39.400 | | | NPDES |
| | | IN0036072 | | | 14 | 779.360 | | | NPDES |
| | | NH0001503 | | | 1 | 27000.000 | | | NPDES |
| AS | Pilot | 241B | | 100-1000 | 5 | 9.000 | | 96.6 | WERL |
| AS | Pilot | 252E | | 100000-1000000 | 6 | 900.000 | | 99.7 | WERL |
| AS | Pilot | 252E | | 10000-100000 | 7 | 500.000 | | 99 | WERL |
| * PACT | Bench | Zimpro | | 2300 | 1 | 14.000 | | 99.39 | WAO * |
| * PACT | Bench | Zimpro | | 266 | 1 | 1.000 | | 99.6 | WAO * |
| * PACT | Bench | Zimpro | | 300 | 1 | 0.010 | | 99.9 | WAO * |
| WOx | Pilot | Zimpro | | | | | | 99.9 | WAO |
| WOx | Full | 242E | | 1000000 | | 2300.000 | | 99.9 | WERL |
| WOx + PACT | Pilot | Zimpro | 100 | 130000-250000 | 3 | 100 | | 99.9 | WAO |
| WOx [B] | Bench | 78D | | 1000000 | | 1000.000 | | 99.9 | WERL |
| WOx [B] | Bench | 78D | | 100000-1000000 | | 1000.000 | | 99.6 | WERL |

TABLE 4-32B
INDUSTRY SUBMITTED LEACHATE TREATMENT PERFORMANCE
DATA FOR METHYL ETHYL KETONE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| BT | | CHM | 100 | 2000-19000 | 3 | 100.000 | | 98.78 | LEACHATE |
| BT | B | CHM | 100 | -7067 | 3 | 100.000 | | 98.58 | LEACHATE |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR METHYL ISOBUTYL KETONE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| | | NH0001503 | | | 1 | 70900.000 | | | NPDES |
| AS | Pilot | REF2 | | 76400 | 6 | 41817.000 | | | BDAT # |
| AS | Pilot | 241B | | 100-1000 | 4 | 6.000 | | 98.1 | WERL |
| RO | Full | 250B | | 100-1000 | | 15.000 | | 89.9 | WERL |
| * SS | Pilot | REF2 | | 76400 | 5 | 10.000 | | | BDAT # * |
| WOx | Full | 242E | | 100000-1000000 | | 5.000 | | 99.99 | WERL |
| WOx + PACT | Pilot | Zimpro | 50 | 620000-830000 | 3 | 50.000 | | | WAO |

# ITD data presented in the BDAT Solvents Rule F001-F005 Background Document.

INDUSTRY SUBMITTED LEACHATE TREATMENT PERFORMANCE
DATA FOR METHYL ISOBUTYL KETONE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| BT | | CHM | 50 | 1400-7800 | 3 | 50.000 | | 98.61 | LEACHATE |
| BT | BS | CHM | 50 | -2167 | 3 | 50.000 | | 97.69 | LEACHATE |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR METHYLENE CHLORIDE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AS | Full | 1B | | 0-100 | 3 | 23.000 | | 64 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 17.000 | | 72 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 31.000 | | 31 | WERL |
| AS | Full | 234A | | 0-100 | | 2.000 | | 93.3 | WERL |
| AS | Full | 201B | | 0-100 | 27 | 45.000 | | 51 | WERL |
| AS | Full | 975B | | 0-100 | | 0.430 | | 92 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 9.000 | | 75 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 46.000 | | 69 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 130.000 | | 54 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 23.000 | | 57 | WERL |
| AS | Full | 6B | | 0-100 | 3 | 10.000 | | 77 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 61.000 | | 34 | WERL |
| AS | Full | 238A | | 0-100 | 3 | 11.000 | | 78 | WERL |
| AS | Full | 234A | | 0-100 | | 4.900 | | 56 | WERL |
| AS | Bench | 202D | | 100000-1000000 | | 510.000 | | 99.72 | WERL |
| AS | Full | 375E | | 0-100 | 7 | 10.000 | | 69 | WERL |
| AS | Full | 6B | | 1000-10000 | 40 | 54.000 | | 98.6 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 16.000 | | 72 | WERL |
| AS | Full | 6B | | 1000-10000 | 10 | 31.000 | | 99.53 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 23.000 | | 74 | WERL |
| AS | Full | 6B | | 1000-10000 | 3 | 10.000 | | 99.74 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 17.000 | | 77 | WERL |
| AS | Full | 1B | | 1000-10000 | 5 | 56.000 | | 97.8 | WERL |
| AS | Full | 6B | | 0-100 | 10 | 13.000 | | 79 | WERL |
| AS | Full | 1B | | 100-1000 | 5 | 560.000 | | 31 | WERL |
| AS | Pilot | 206B | | 100-1000 | 20 | 4.000 | | 96.6 | WERL |
| AS | Full | 1168E | | 10000-100000 | | 920.000 | | 98.4 | WERL |
| AS | Full | 234A | | 100-1000 | | 0.800 | | 99.5 | WERL |
| AS | Full | 1B | | 10000-100000 | 5 | 12000.000 | | 14 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 17.000 | | 64 | WERL |
| AS | Pilot | 241B | | 100-1000 | 5 | 110.000 | | 78 | WERL |
| AS | Full | 375E | | 0-100 | 7 | 5.000 | | 80 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 61.000 | | 34 | WERL |
| AS | Full | 375E | | 1000-10000 | 7 | 55.000 | | 99.3 | WERL |
| AS | Full | 1B | | 1000-10000 | 5 | 2000.000 | | 5 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 62.000 | | 35 | WERL |
| AS | Full | 375E | | 0-100 | 7 | 20.000 | | 64 | WERL |
| AS+Fil | Full | 6B | | 0-100 | 9 | 29.000 | | 26 | WERL |
| AirS | Pilot | 205E | | 100-1000 | | 3.000 | | 99.6 | WERL |
| AirS | Pilot | 1362E | | 100-1000 | 3 | 5.300 | | 99 | WERL |
| AirS+GAC | Full | 229A | | 100-1000 | 19 | 1.000 | | 99.8 | WERL |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR METHYLENE CHLORIDE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| BT | Full | P246 | | 27-3907 | 13 | 11.000 | | | BDAT ∮ |
| BT | Full | P265 | | 500-750 | 3 | 27.000 | | | BDAT ∮ |
| BT+AC | Full | P246 | | 10-5550 | 28 | 10.000 | | | BDAT ∮ |
| CAC+Alr8 | Full | 1833D | | 0-100 | 25 | 2.400 | | 92.3 | WERL |
| GAC | Full | 245B | | 100-1000 | 1 | 10.000 | | 99 | WERL |
| GAC | Full | 237A | | 100-1000 | 1 | 10.000 | | 94.4 | WERL |
| PACT | Bench | 242E | | 0-100 | | 20.000 | | 76 | WERL |
| PACT | Bench | Zimpro | | 84 | 1 | 20.000 | | 76 | WAO |
| RO | Full | 250B | | 100-1000 | | 80.000 | | 66 | WERL |
| RO | Full | 250B | | 10000-100000 | | 15000.000 | | 44 | WERL |
| * SS | Full | 725 | 10 | 10-5100 | 13 | 217.300 | | | ITD-L * |
| * SS | Full | 913 | 10 | 200-10400 | 14 | 10.000 | | | ITD-L * |
| * SS | Full | 415T | 10 | 198-12100 | 15 | 10.500 | | | ITD-L * |
| SS | Full | 6B | | 1000-10000 | 15 | 10.000 | | 99.52 | WERL |
| SS | Full | 251B | | 1000-10000 | 10 | 10.000 | | 99.17 | WERL |
| SS | Full | 251B | | 1000000 | 10 | 11.000 | | 100 | WERL |
| SS | Full | 6B | | 1000-10000 | 9 | 78.000 | | 95.1 | WERL |
| SS | Full | P12003 | | 225000-12000000 | 40 | 24413.000 | | | BDAT ∮ |
| SS | Full | 6B | | 100-1000 | 2 | 10.000 | | 99 | WERL |
| SS | Full | P284 | | 198-12100 | 15 | 10.000 | | | BDAT ∮ |
| TF | Full | 1B | | 0-100 | 5 | 20.000 | | 67 | WERL |
| TF | Full | 375E | | 0-100 | 7 | 12.000 | | 8 | WERL |
| TF | Full | 1B | | 0-100 | 3 | 23.000 | | 36 | WERL |
| TF | Full | 1B | | 0-100 | 5 | 58.000 | | 40 | WERL |
| TF | Full | 1B | | 0-100 | 5 | 21.000 | | 77 | WERL |
| TF | Full | 1B | | 100-1000 | 6 | 16.000 | | 89 | WERL |
| TF | Full | 1B | | 100-1000 | 4 | 120.000 | | 56 | WERL |
| TF | Full | 375E | | 100-1000 | 7 | 21.000 | | 88 | WERL |
| TF | Full | 1B | | 100-1000 | 5 | 37.000 | | 66 | WERL |
| WOx | | REF10 | | 15000-3600000 | 3 | 5000.000 | | | BDAT ∮ |
| WOx | Pilot | Zimpro | | 60000 | 1 | 10.000 | | 99.9 | WAO |
| WOx | Pilot | 78D | | 10-100 | | 10.000 | | 99.98 | WERL |
| WOx | Full | 242E | | 100000-1000000 | | 84.000 | | 99.99 | WERL |

∮ ITD data presented in the BDAT Solvents Rule F001-F005 Background Document.

WASTEWATER TREATMENT PERFORMANCE DATA
FOR TOLUENE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AL | Full | 6B | | 100-1000 | 3 | 10.000 | | 98.2 | WERL |
| AL | Bench | 371D | | 1000-10000 | | 90.000 | | 97 | WERL |
| AL | Full | 1B | | 100-1000 | 6 | 32.000 | | 96.1 | WERL |
| AL+AS | Full | 233D | | 1000-10000 | 21 | 4.000 | | 99.85 | WERL |
| API+DAF+AS | Full | 1482D | | 10000-100000 | 4 | 11.000 | | 99.93 | WERL |
| AS | Bench | 202D | | 10000-100000 | | 10.000 | | 99.98 | WERL |
| AS | Full | 6B | | 10000-100000 | 3 | 73.000 | | 99.84 | WERL |
| AS | Full | 6B | | 1000-10000 | 3 | 10.000 | | 99.57 | WERL |
| AS | Full | 975B | | 1000-10000 | | 12.000 | | 99.68 | WERL |
| AS | Full | 6B | | 10000-100000 | 3 | 76.000 | | 99.90 | WERL |
| AS | Bench | 200B | | 100-1000 | 10 | 0.800 | | 99.3 | WERL |
| AS | Full | 6B | | 1000-10000 | 24 | 10.000 | | 99.73 | WERL |
| AS | Full | 1B | | 1000-10000 | 6 | 9.000 | | 99.81 | WERL |
| AS | Full | 6B | | 1000-10000 | 15 | 10.000 | | 99.88 | WERL |
| AS | Full | 6B | | 1000-10000 | 3 | 24.000 | | 99.76 | WERL |
| AS | Full | 975B | | 1000-10000 | | 280.000 | | 96.3 | WERL |
| AS | Full | 6B | | 1000-10000 | 7 | 10.000 | | 99.5 | WERL |
| AS | Full | 975B | | 100-1000 | | 23.000 | | 86 | WERL |
| AS | Full | 6B | | 1000-10000 | 33 | 20.000 | | 99.8 | WERL |
| AS | Pilot | 226B | | 100000-1000000 | 7 | 300.000 | | 99.85 | WERL |
| AS | Full | 6B | | 100-1000 | 14 | 10.000 | | 97.8 | WERL |
| AS | Full | 6B | | 100-1000 | 4 | 10.000 | | 97.6 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 4.000 | | 88 | WERL |
| AS | Full | 975B | | 100-1000 | | 7.600 | | 99.04 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 4.000 | | 99.48 | WERL |
| AS | Full | 234A | | 0-100 | | 0.700 | | 97.1 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 3.000 | | 90.6 | WERL |
| AS | Full | 1587E | | 0-100 | | 0.100 | | 99 | WERL |
| AS | Full | 201B | | 100-1000 | 32 | 57.000 | | 87 | WERL |
| AS | Full | 1B | | 100-1000 | 5 | 12.000 | | 96.8 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 1.000 | | 98 | WERL |
| AS | Full | 234A | | 0-100 | | 0.200 | | 96.2 | WERL |
| AS | Full | 1B | | 100-1000 | 4 | 4.000 | | 96.4 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 2.000 | | 97.6 | WERL |
| AS | Full | 238A | | 0-100 | 3 | 6.200 | | 92.7 | WERL |
| AS | Full | 6B | | 100-1000 | 3 | 10.000 | | 94.4 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 2.000 | | 97.1 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 4.000 | | 86 | WERL |
| AS | Pilot | 241B | | 100-1000 | 5 | 4.000 | | 98.6 | WERL |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR TOLUENE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AS | Full | 234A | | 0-100 | | 0.200 | | 96.9 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 3.000 | | 94 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 20.000 | | 89 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 1.000 | | 97.3 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 1.000 | | 97.4 | WERL |
| AS | Full | 234A | | 0-100 | | 0.200 | | 97.7 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 2.000 | | 96.3 | WERL |
| AS | Full | 1B | | 100-1000 | 5 | 56.000 | | 93.8 | WERL |
| AS | Pilot | 206B | | 100-1000 | 20 | 0.600 | | 99.76 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 10.000 | | 96.4 | WERL |
| AS | Full | 234A | | 100-1000 | | 0.200 | | 99.9 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 31.000 | | 95.4 | WERL |
| AS | Pilot | REF2 | | 92000 | 6 | 23467.000 | | | BDAT # |
| AS + Fil | Full | 6B | | 10000-100000 | 3 | 10.000 | | 99.98 | WERL |
| AirS | Full | 322B | | 100-1000 | 24 | 0.660 | | 99.77 | WERL |
| AirS | Pilot | 1362E | | 0-100 | 3 | 1.700 | | 95.3 | WERL |
| AirS | Bench | 1328E | | 10000-100000 | 5 | 2800.000 | | 92.4 | WERL |
| AirS | Full | 69A | | 0-100 | | 0.940 | | 97 | WERL |
| AirS | Full | 322B | | 0-100 | 5 | 2.000 | | 97.4 | WERL |
| AirS | Pilot | 224B | | 0-100 | 1 | 0.500 | | 98.9 | WERL |
| AirS | Full | 322B | | 1000-10000 | 6 | 34.000 | | 99.18 | WERL |
| AirS | Full | 322B | | 10000-100000 | 3 | 114.000 | | 99.33 | WERL |
| AirS+GAC | Full | 229A | | 0-100 | 19 | 1.000 | | 90 | WERL |
| BT | Full | P206 | | 834-57475 | 10 | 1491.000 | | | BDAT # |
| BT | Full | P211 | | 1154-4000 | 7 | 10.000 | | | BDAT # |
| BT | Full | P202 | | 60-155 | 20 | 10.000 | | | BDAT # |
| BT | Full | P244 | | 1109 | 1 | 10.000 | | | BDAT # |
| BT | Full | P210 | | 135-5805 | 2 | 10.000 | | | BDAT # |
| BT | Full | P223 | | 99-265 | 3 | 10.000 | | | BDAT # |
| BT | Full | P217 | | 34400-60000 | 3 | 73.000 | | | BDAT # |
| BT | Full | P234 | | 2350-35000 | 32 | 21.000 | | | BDAT # |
| BT | Full | P242 | | 1200-1533 | 2 | 10.000 | | | BDAT # |
| BT | Full | P221 | | 10-323 | 3 | 10.000 | | | BDAT # |
| BT | Full | P208 | | 140-640 | 14 | 10.000 | | | BDAT # |
| BT | Full | P240 | | 22700 | 1 | 10.000 | | | BDAT # |
| BT | Full | P246 | | 77-12938 | 9 | 630.000 | | | BDAT # |
| BT | Full | P251 | | 15840-26060 | 3 | 10.000 | | | BDAT # |
| BT | Full | P253 | | 66-230 | 3 | 103.000 | | | BDAT # |
| BT | Full | P257 | | 1730-12900 | 27 | 12.000 | | | BDAT # |
| BT | Full | P265 | | 37750-50000 | 3 | 10.000 | | | BDAT # |

# ITD data presented in the BDAT Solvents Rule F001-F005 Background Document.

WASTEWATER TREATMENT PERFORMANCE DATA
FOR TOLUENE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| BT | Full | P286 | | 24000-160000 | 3 | 76.000 | | | BDAT # |
| BT | Full | P215 | | 3300-4550 | 3 | 10.000 | | | BDAT # |
| BT | Full | P230 | | 3503-30347 | 15 | 10.000 | | | BDAT # |
| BT | Full | REF4 | | 680 | 1 | 4.000 | | | BDAT # |
| BT+AC | Full | P246 | | 77-12938 | 10 | 113.000 | | | BDAT # |
| GAC | Pilot | 435B | | 10000-100000 | | 10.000 | | 99.96 | WERL |
| GAC | Full | 245B | | 10000-100000 | 1 | 10.000 | | 99.94 | WERL |
| GAC | Pilot | REF7 | | 120 | 1 | 0.300 | | | BDAT # |
| PACT | Bench | 200B | | 100-1000 | 13 | 0.300 | | 99.75 | WERL |
| PACT | Bench | 242E | | 0-100 | | 5.000 | | 91.2 | WERL |
| PACT | Bench | Zimpro | | 2730 | 1 | 1.000 | | 99.9 | WAO |
| PACT | Bench | Zimpro | | 57 | 1 | 5.000 | | 91 | WAO |
| RO | Full | 250B | | 100-1000 | | 20.000 | | 92.5 | WERL |
| RO | Pilot | 250B | | 0-100 | | 12.000 | | 86 | WERL |
| RO | Full | 250B | | 1000-10000 | | 420.000 | | 94.7 | WERL |
| * SS | | 0415** | 10 | 19300-29000 | 3 | 12.000 | | | ITD-L * |
| SS | Full | 6B | | 1000-10000 | 2 | 10.000 | | 99.71 | WERL |
| SS | Full | 6B | | 10000-100000 | 3 | 12.000 | | 99.95 | WERL |
| * SS | | 0415* | 10 | 2570-4230 | 4 | 22.300 | | | ITD-L * |
| SS | Pilot | REF4 | | 92000 | 5 | 42.000 | | | BDAT # |
| SS | Full | P246 | | 57-98 | 4 | 10.000 | | | BDAT # |
| SS+AC | Full | P297 | | 640-8650 | 3 | 11.000 | | | BDAT # |
| TF | Full | 6B | | 100-1000 | 3 | 10.000 | | 96.3 | WERL |
| TF | Full | 1B | | 0-100 | 5 | 10.000 | | 88 | WERL |
| TF | Full | 1B | | 0-100 | 6 | 7.000 | | 86 | WERL |
| TF | Full | 1B | | 0-100 | 5 | 2.000 | | 97.2 | WERL |
| TF | Full | 1B | | 0-100 | 6 | 1.000 | | 98.2 | WERL |
| TF | Full | 1B | | 100-1000 | 4 | 7.000 | | 97.8 | WERL |
| UF | Pilot | 250B | | 100-1000 | | 84.000 | | 35 | WERL |
| WOx | | REF10 | | 8500000 | 1 | 200000.000 | | | BDAT # |
| WOx | Bench | Zimpro | | 4330000 | 1 | 12000.000 | | 99.7 | WAO |
| WOx | Bench | Zimpro | | 5000 | 1 | 500.000 | | 90 | WAO |
| WOx | Pilot | Zimpro | | 30000 | 1 | 500.000 | | 98.3 | WAO |
| WOx | Full | Zimpro | 50 | 62000-82000 | 2 | 10950.000 | | | WAO |
| WOx | Full | 242E | | 100-1000 | | 57.000 | | 72 | WERL |
| WOx | Pilot | 78D | | 10000-100000 | | 500.000 | | 98.3 | WERL |
| WOx | Pilot | Zimpro | 5 | 130000-180000 | 3 | 5.000 | | 99.9 | WAO |
| WOx | Bench | 78D | | 1000-10000 | | 500.000 | | 90 | WERL |
| WOx | Bench | 78D | | 10000-100000 | | 1000.000 | | 98.8 | WERL |
| WOx | Bench | 1054E | | 10000-100000 | | 500.000 | | 98.9 | WERL |
| WOx | Bench | 1054E | | 1000000 | | 220000.000 | | 95.7 | WERL |

# ITD data presented in the BDAT Solvents Rule F001-F005 Background Document.

WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,1,1-TRICHLOROETHANE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AL | Full | 1B | | 0-100 | 5 | 10.000 | | 90 | WERL |
| AS | Full | 201B | | 0-100 | 6 | 21.000 | | 79 | WERL |
| AS | Full | 1B | | 0-100000 | 4 | 10.000 | | 89 | WERL |
| AS | Full | 234A | | 1000-10000 | | 1.300 | | 99.88 | WERL |
| AS | Full | 1B | | 1000-10000 | 6 | 850.000 | | 87 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 9.000 | | 84 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 10.000 | | 84 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 10.000 | | 81 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 12.000 | | 90 | WERL |
| AS | Full | 6B | | 100-1000 | 3 | 10.000 | | 98.9 | WERL |
| AS | Full | 375E | | 0-100 | 7 | 1.000 | | 92.3 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 12.000 | | 87 | WERL |
| AS | Full | 975B | | 100-1000 | | 4.000 | | 98.1 | WERL |
| AS | Full | 234A | | 0-100 | | 1.000 | | 97.6 | WERL |
| AS | Pilot | 206B | | 100-1000 | 20 | 0.300 | | 99.77 | WERL |
| AS | Full | 1B | | 100-1000 | 5 | 54.000 | | 89 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 5.000 | | 96.2 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 30.000 | | 39 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 5.000 | | 95 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 28.000 | | 94.3 | WERL |
| AS | Full | 234A | | 0-100 | | 1.300 | | 76 | WERL |
| AS | Full | 238A | | 0-100 | 3 | 2.200 | | 85 | WERL |
| AS | Full | 234A | | 0-100 | | 1.300 | | 73 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 2.000 | | 95.8 | WERL |
| AS | Full | 238A | | 0-100 | 3 | 2.900 | | 77 | WERL |
| AS | Full | 1587E | | 100-1000 | | 0.270 | | 99.73 | WERL |
| AS | Full | 1B | | 100-1000 | 5 | 100.000 | | 70 | WERL |
| AS | Full | 375E | | 0-100 | 7 | 1.000 | | 92.3 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 7.000 | | 83 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 8.000 | | 84 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 2.000 | | 95.8 | WERL |
| AS | Pilot | 241B | | 100-1000 | 5 | 8.000 | | 97.2 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 1.000 | | 98.4 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 4.000 | | 88 | WERL |
| AS | Full | 234A | | 0-100 | | 1.300 | | 88 | WERL |
| AS | Bench | 202D | | 100000-1000000 | | 1600.000 | | 98.6 | WERL |
| AS | Pilot | REF6 | | 237 | 1 | 23.000 | | | BDAT ◊ |
| AS | Pilot | REF2 | | 150000 | 6 | 48683.000 | | | BDAT ◊ |

◊ ITD data presented in the BDAT Solvents Rule F001-F005 Background Document.

WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,1,1-TRICHLOROETHANE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AirS | Pilot | 211B | | 0-100 | 1 | 1.000 | | 98.8 | WERL |
| AirS | Pilot | 207B | | 0-100 | 1 | 0.500 | | 97.5 | WERL |
| AirS | Pilot | 812E | | 1000-10000 | | 49.000 | | 95.9 | WERL |
| AirS | Pilot | 222B | | 100-1000 | 1 | 1.100 | | 99.75 | WERL |
| AirS | Pilot | 812E | | 0-100 | | 3.000 | | 92.9 | WERL |
| AirS | Pilot | 211B | | 100-1000 | 1 | 1.700 | | 99.5 | WERL |
| AirS | Pilot | 1362E | | 1000-10000 | 3 | 130.000 | | 97.8 | WERL |
| AirS | Pilot | 812E | | 100-1000 | | 12.000 | | 89 | WERL |
| AirS | Pilot | 217B | | 0-100 | 1 | 0.300 | | 97 | WERL |
| AirS | Pilot | 205E | | 100-1000 | | 7.000 | | 96.8 | WERL |
| AirS | Full | 1344E | | 100-1000 | | 0.200 | | 99.98 | WERL |
| AirS | Pilot | 219B | | 0-100 | 1 | 0.500 | | 96.7 | WERL |
| BT | Full | P240 | | 10-215 | 3 | 10.000 | | | BDAT ◊ |
| GAC | Bench | 1362E | | 10-100 | | 1.000 | | 99.99 | WERL |
| GAC | Full | 1264B | | 0-100 | | 1.000 | | 96.6 | WERL |
| GAC | Full | 1264B | | 100-1000 | | 1.000 | | 99.35 | WERL |
| GAC | Pilot | 812E | | 100-1000 | | 1.000 | | 99.05 | WERL |
| PACT | Bench | 242E | | 100-1000 | | 25.000 | | 93.8 | WERL |
| PACT | Bench | Zimpro | | 4970 | 1 | 1.000 | | 99.9 | WAO |
| PACT | Bench | Zimpro | | 405 | 1 | 25.000 | | 93.8 | WAO |
| RO | Pilot | 180A | | 0-100 | | 0.050 | | 98.2 | WERL |
| RO | Full | 250B | | 100-1000 | | 36.000 | | 95.6 | WERL |
| RO | Pilot | 323B | | 0-100 | 1 | 2.000 | | 97.8 | WERL |
| RO | Full | 250B | | 100-1000 | | 10.000 | | 93.8 | WERL |
| SS | Full | 6B | | 10000-100000 | | 10.000 | | 99.94 | WERL |
| * SS | Full | 913 | 10 | 11900-35000 | 14 | 10.000 | | | ITD-L * |
| SS | Pilot | REF2 | | 150000 | 5 | 463.000 | | | BDAT ◊ |
| TF | Full | 375E | | 0-100 | 7 | 1.000 | | 50 | WERL |
| TF | Full | 1B | | 0-100 | 5 | 2.000 | | 92.6 | WERL |
| TF | Full | 1B | | 100-1000 | 6 | 2.000 | | 98.3 | WERL |
| TF | Full | 1B | | 0-100 | 5 | 5.000 | | 92.2 | WERL |
| UV [B] | Bench | 1138E | | 0-100 | | 30.000 | | 40 | WERL |
| WOx | | REF10 | | 370000 | 1 | 1000.000 | | | BDAT ◊ |
| WOx | Full | Zimpro | 50 | 6900-9600 | 2 | | | | WAO |
| WOx | Full | 242E | | 100000-1000000 | | 400.000 | | 99.96 | WERL |

◊ ITD data presented in the BDAT Solvents Rule F001-F005 Background Document.

WASTEWATER TREATMENT PERFORMANCE DATA
FOR TRICHLOROETHENE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AS | Bench | 202D | | 10000-100000 | | 210.000 | | 99.78 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 5.000 | | 89 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 2.000 | | 99.23 | WERL |
| AS | Full | 6B | | 100-1000 | 3 | 10.000 | | 94.1 | WERL |
| AS | Full | 1587E | | 0-100 | | 0.100 | | 95.7 | WERL |
| AS | Full | 375E | | 0-100 | 7 | 2.500 | | 58 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 1.000 | | 96.7 | WERL |
| AS | Pilot | 206B | | 100-1000 | 20 | 1.500 | | 98.6 | WERL |
| AS | Full | 238A | | 0-100 | 3 | 2.100 | | 90.6 | WERL |
| AS | Full | 1B | | 100-1000 | 4 | 3.000 | | 97.3 | WERL |
| AS | Pilot | 241B | | 100-1000 | 5 | 7.000 | | 96.7 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 64.000 | | 87 | WERL |
| AS | Full | 234A | | 0-100 | | 0.700 | | 71 | WERL |
| AS | Full | 201B | | 0-100 | 6 | 13.000 | | 87 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 2.000 | | 97.6 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 1.000 | | 98.5 | WERL |
| AS | Full | 6B | | 0-100 | 5 | 10.000 | | 89 | WERL |
| AS | Full | 238A | | 0-100 | 3 | 0.500 | | 94.8 | WERL |
| AS | Full | 234A | | 0-100 | | 0.700 | | 92.3 | WERL |
| AS | Full | 1B | | 100-1000 | 5 | 31.000 | | 74 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 87.000 | | 87 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 4.000 | | 89.7 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 37.000 | | 92.6 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 16.000 | | 72 | WERL |
| AirS | Pilot | 1362E | | 1000-10000 | 3 | 1.000 | | 99.94 | WERL |
| AirS | Pilot | 209B | | 100-1000 | 1 | 0.800 | | 99.58 | WERL |
| AirS | Full | 199B | | 100-1000 | | 1.500 | | 99.75 | WERL |
| AirS | Pilot | 26A | | 100-1000 | | 27.000 | | 87 | WERL |
| AirS | Pilot | 216B | | 100-1000 | 1 | 2.100 | | 98.9 | WERL |
| AirS | Pilot | 219B | | 100-1000 | 1 | 0.500 | | 99.58 | WERL |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR TRICHLOROETHENE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AirS | Pilot | 369A | | 0-100 | | 0.300 | | 99.44 | WERL |
| AirS | Pilot | 211B | | 100-1000 | 1 | 3.100 | | 98.6 | WERL |
| AirS | Pilot | 205E | | 0-100 | | 1.000 | | 97.2 | WERL |
| AirS | Pilot | 220B | | 100-1000 | 1 | 0.200 | | 99.92 | WERL |
| AirS | Pilot | 217B | | 100-1000 | 1 | 1.200 | | 99.69 | WERL |
| AirS | Full | 322B | | 100-1000 | 10 | 0.460 | | 99.91 | WERL |
| AirS | Pilot | 1327E | | 1000-10000 | | 190.000 | | 91.3 | WERL |
| AirS | Pilot | 212B | | 0-100 | 1 | 0.400 | | 99.6 | WERL |
| AirS | Full | 223B | | 0-100 | 1 | 0.500 | | 98.2 | WERL |
| AirS | Full | 69A | | 0-100 | | 1.400 | | 98.1 | WERL |
| AirS | Pilot | 369A | | 0-100 | | 3.000 | | 93.2 | WERL |
| AirS | Pilot | 221B | | 0-100 | 1 | 0.500 | | 99.44 | WERL |
| AirS | Pilot | 1585E | | 0-100 | 1 | 4.300 | | 87 | WERL |
| AirS | Pilot | 1363E | | 100-1000 | | 5.000 | | 97.1 | WERL |
| AirS | Pilot | 1327E | | 0-100 | | 4.300 | | 87 | WERL |
| AirS | Pilot | 211B | | 1000-10000 | 1 | 7.700 | | 99.3 | WERL |
| AirS | Full | 1042E | | 0-100 | | 0.300 | | 99.68 | WERL |
| AirS | Pilot | 215B | | 0-100 | 1 | 0.500 | | 98 | WERL |
| AirS | Pilot | 208B | | 0-100 | 1 | 0.700 | | 99.03 | WERL |
| AirS | Pilot | 222B | | 0-100 | 1 | 0.300 | | 99.21 | WERL |
| AirS | Full | 322B | | 1000-10000 | 7 | 11.000 | | 99.77 | WERL |
| AirS | Pilot | 1585E | | 1000-10000 | 1 | 170.000 | | 84 | WERL |
| AirS | Pilot | 71D | | 100-1000 | 1 | 5.000 | | 98.5 | WERL |
| AirS | Pilot | 207B | | 0-100 | 1 | 0.500 | | 98.7 | WERL |
| BT | Full | REF4 | | 60 | 1 | 5.800 | | | BDAT ◊ |
| BT | Full | P213 | | 16-76 | 3 | 10.000 | | | BDAT ◊ |
| BT | Full | P217 | | 98-224 | 3 | 10.000 | | | BDAT ◊ |
| BT | Full | P253 | | 484 | 1 | 16.000 | | | BDAT ◊ |
| BT+AC | Full | P246 | | 40-70 | 3 | 10.000 | | | BDAT ◊ |
| CAC+AirS | Full | 1833D | | 0-100 | 20 | 0.200 | | 90 | WERL |
| ChOx | Pilot | 2026A | | 0-100 | 4 | 3.700 | | 96.2 | WERL |

◊ ITD data presented in the BDAT Solvents Rule F001-F005 Background Document.

WASTEWATER TREATMENT PERFORMANCE DATA
FOR TRICHLOROETHENE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| ChOx | Pilot | 2026A | | 100-1000 | | 7.100 | | 94.4 | WERL |
| Chred | Pilot | | | 200 | 1 | 5.000 | | | ART |
| Chred | Bench | | | 280 | 1 | 3.900 | | | ART |
| Chred | Bench | | | 300 | 1 | 0.400 | | | ART |
| GAC | Full | 1264B | | 100-1000 | | 1.000 | | 99.36 | WERL |
| GAC | Full | 1264B | | 0-100 | | 1.000 | | 98.8 | WERL |
| GAC | Full | 245B | | 100-1000 | 1 | 10.000 | | 97.8 | WERL |
| GAC | Full | 1264B | | 0-100 | | 1.300 | | 98.6 | WERL |
| GAC | Full | 245B | | 1000-10000 | 1 | 10.000 | | 99.46 | WERL |
| GAC | Full | 237A | | 100-1000 | 1 | 10.000 | | 95.8 | WERL |
| GAC | Pilot | REF8 | | 171 | 1 | 0.590 | | | BDAT # |
| PACT | Bench | 242E | | 0-100 | | 10.000 | | 89 | WERL |
| PACT | Bench | Zimpro | | 326 | 1 | 1.000 | | 99.7 | WAO |
| PACT | Bench | Zimpro | | 90 | 1 | 10.000 | | 89 | WAO |
| PACT | Bench | Zimpro | | 32.8 | 1 | 0.005 | | 99.98 | WAO |
| RO | Full | 250B | | 100-1000 | | 110.000 | | 78 | WERL |
| RO | Full | 250B | | 0-100 | | 5.500 | | 79 | WERL |
| RO | Pilot | 323B | | 0-100 | 1 | 68.000 | | 30 | WERL |
| * SS | Full | 415 | 10 | 59-10300 | 15 | 16.100 | | | ITD-L * |
| SS | Full | 251B | | 1000-10000 | 10 | 5.000 | | 99.91 | WERL |
| SS | Full | 6B | | 1000-10000 | 14 | 16.000 | | 99.20 | WERL |
| SS | Full | 6B | | 10000-100000 | 2 | 10.000 | | 99.97 | WERL |
| SS | Full | 251B | | 1000-10000 | 10 | 10.000 | | 99.79 | WERL |
| * SS | Full | 913 | 10 | 22900-52700 | 14 | 10.000 | | | ITD-L * |
| SS | Full | P284 | | 10-10300 | 15 | 16.000 | | | BDAT # |
| TF | Full | 1B | | 0-100 | 6 | 1.000 | | 98.8 | WERL |
| TF | Full | 1B | | 100-1000 | 5 | 1.000 | | 99.33 | WERL |
| TF | Full | 1B | | 0-100 | 5 | 1.000 | | 98.5 | WERL |
| TF | Full | 1B | | 0-100 | 5 | 1.000 | | 98.4 | WERL |
| TF | Full | 1B | | 0-100 | 6 | 5.000 | | 93.2 | WERL |
| UV (B) | Bench | 1138E | | 0-100 | | 22.000 | | 56 | WERL |
| WOx | Bench | Zimpro | | 500000 | 1 | 1700.000 | | 99.7 | WAO |
| WOx | Bench | Zimpro | | 300000 | 1 | 2000.000 | | 99.3 | WAO |
| WOx (B) | Bench | 78D | | 100000-1000000 | | 1700.000 | | 99.66 | WERL |

# ITD data presented in the BDAT Solvents Rule F001-F005 Background Document.

WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,2-XYLENE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| | | NY0183628 | | | 3 | 198.330 | | | NPDES |
| AS | Full | 1587E | | 0-100 | | 0.100 | | 98.6 | WERL |
| AS | Bench | 200B | | 100-1000 | 15 | 0.900 | | 99.2 | WERL |
| AirS | Pilot | 224B | | 0-100 | 1 | 0.500 | | 93 | WERL |
| PACT | Bench | 242E | | 0-100 | | 5.000 | | 93.7 | WERL |
| PACT | Bench | Zimpro | | 79 | 1 | 5.000 | | 94 | WAO |
| RO | Full | 250B | | 10000-100000 | | 300.000 | | 97.8 | WERL |
| * WOx | Full | 242E | | 10000-100000 | | 79.000 | | 99.92 | WERL * |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,3-XYLENE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| | | NY0183628 | | | 3 | 193.330 | | | NPDES |
| AS | Full | 1587E | | 0-100 | | 0.100 | | 98.3 | WERL |
| AirS | Pilot | 224B | | 0-100 | 1 | 0.500 | | 72 | WERL |
| GAC | Full | 1421D | | 0-100 | | 0.130 | | 20 | WERL |
| PACT | Bench | 242E | | 0-100 | | 10.000 | | 70 | WERL |
| PACT | Bench | Zimpro | | 33 | 1 | 10.000 | | 70 | WAO |
| * WOx | Full | 242E | | 10000-100000 | | 33.000 | | 99.7 | WERL * |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,4-XYLENE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| | | NY0183628 | | | 3 | 198.330 | | | NPDES |
| AirS | Pilot | 224B | | 0-100 | 1 | 0.500 | | 90 | WERL |
| GAC | Full | 1421D | | 0-100 | | 0.040 | | 37 | WERL |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR XYLENE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| GAC | Pilot | REF7 | | 140 | 1 | 0.100 | | | BDAT # |
| WOx | | REF10 | | 21200 | 1 | 500.000 | | | BDAT # |
| WOx | Pilot | Zimpro | | 8385000 | 1 | 20000.000 | | 99.8 | WAO |

# ITD data presented in the BDAT Solvents Rule F001-F005 Background Document.

WASTEWATER TREATMENT PERFORMANCE DATA
FOR ACETOPHENONE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| * | | NN0001571 | | | 32 | 10361.560 | | | NPDES * |

INDUSTRY SUBMITTED LEACHATE TREATMENT PERFORMANCE
DATA FOR ACETOPHENONE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| BT | | CNM | 2.9 | 35 | 1 | 2.900 | | 91.71 | LEACHATE |

## WASTEWATER TREATMENT PERFORMANCE DATA FOR BIS(2-ETHYLHEXYL)PHTHALATE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AL | Pilot | 203A | | 100-1000 | 11 | 34.000 | | 80 | WERL |
| AL | Full | 1B | | 100-1000 | 6 | 73.000 | | 39 | WERL |
| AL | Bench | 371D | | 1000-10000 | | 190.000 | | 90.5 | WERL |
| AL | Pilot | 203A | | 100-1000 | 11 | 30.000 | | 82 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 8.000 | | 79 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 18.000 | | 47 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 5.000 | | 81 | WERL |
| AS | Pilot | 241B | | 100-1000 | 5 | 7.000 | | 93.7 | WERL |
| AS | Pilot | 203A | | 100-1000 | 11 | 18.000 | | 89 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 10.000 | | 84 | WERL |
| AS | Bench | 202D | | 100-1000 | | 60.000 | | 77 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 10.000 | | 66 | WERL |
| AS | Pilot | 241B | | 1000-10000 | 4 | 390.000 | | 64 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 90.000 | | 59 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 11.000 | | 64 | WERL |
| AS | Full | 1B | | 100-1000 | 5 | 31.000 | | 72 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 9.000 | | 67 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 20.000 | | 73 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 67.000 | | 33 | WERL |
| AS | Full | 6B | | 1000-10000 | 37 | 47.000 | | 97.1 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 11.000 | | 76 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 40.000 | | 86 | WERL |
| AS | Full | 201B | | 0-100 | 3 | 5.000 | | 93.8 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 16.000 | | 70 | WERL |
| AS | Pilot | 204A | | 0-100 | 8 | 11.000 | | 79 | WERL |
| AS | Pilot | 240A | | 100-1000 | 10 | 46.000 | | 73 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 48.000 | | 63 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 51.000 | | 39 | WERL |
| AS | Bench | 1050E | | 100-1000 | 5 | 35.000 | | 91.2 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 10.000 | | 81 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 6.000 | | 86 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 190.000 | | 57 | WERL |
| CAC | Pilot | 203A | | 100-1000 | 11 | 15.000 | | 91.1 | WERL |
| * BT | Full | 948 | 10 | 11-11740 | 33 | 43.300 | | | ITD-L * |
| PACT | Bench | 975B | | 100-1000 | | 3.000 | | 99.46 | WERL |
| PACT | Bench | Zimpro | | 561 | 1 | 2.000 | | 99.6 | WAO |
| RO | Full | 250B | | 0-100 | | 8.000 | | 90 | WERL |
| TF | Full | 1B | | 0-100 | 5 | 60.000 | | 3 | WERL |
| TF | Pilot | 203A | | 100-1000 | 11 | 39.000 | | 77 | WERL |
| TF | Full | 1B | | 0-100 | 5 | 5.000 | | 81 | WERL |
| TF | Full | 1B | | 0-100 | 4 | 22.000 | | 24 | WERL |
| TF | Full | 1B | | 0-100 | 6 | 26.000 | | 32 | WERL |
| TF | Full | 1B | | 0-100 | 5 | 33.000 | | 56 | WERL |
| TF | Pilot | 240A | | 100-1000 | 6 | 43.000 | | 79 | WERL |
| WOx | Full | Zimpro | 2 | 4800 | 1 | 10.000 | | | WAO |
| WOx | Full | Zimpro | 11 | 1800 | 1 | 0.000 | | | WAO |
| WOx (B) | Bench | 1054E | | 100000-1000000 | | 100.000 | | 99.99 | WERL |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR BUTYL BENZYL PHTHALATE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| | | LA0065501 | | | 6 | 10.000 | | | NPDES |
| | | NY0199648 | | | 11 | 10.730 | | | NPDES |
| | | NY0032140 | | | 2 | 136.500 | | | NPDES |
| | | NY0032140 | | | 2 | 58.000 | | | NPDES |
| | | PA0022047 | | | 10 | 7.000 | | | NPDES |
| | | NY0183628 | | | 4 | 17.500 | | | NPDES |
| | | LA0066214 | | | 15 | 5.000 | | | NPDES |
| AS | Pilot | 204A | | 0-100 | 8 | 1.300 | | 96.2 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 5.000 | | 91.8 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 2.000 | | 93.8 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 3.000 | | 98.3 | WERL |
| AS | Pilot | 241B | | 0-100 | 5 | 9.000 | | 82 | WERL |
| AS | Pilot | 241B | | 100-1000 | 11 | 12.000 | | 97 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 2.000 | | 96.7 | WERL |
| BT | Full | PA0026247 | | | 25 | 13.795 | | | NPDES |
| BT | Full | LA0038245 | | | 38 | 10.066 | | | NPDES |
| PACT | Bench | Zimpro | | 129 | 1 | 2.000 | | 98.4 | WAO |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR o-DICHLOROBENZENE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AFT | Bench | 501A | | 0-100 | 25 | 0.380 | | 96 | WERL |
| AL | Pilot | 192D | | 100-1000 | | 10.000 | | 97.7 | WERL |
| AL | Pilot | 192D | | 1000-10000 | | 100.000 | | 94.8 | WERL |
| AL | Bench | 371D | | 1000-10000 | | 72.000 | | 97.6 | WERL |
| AS | Full | 1B | | 100-1000 | 4 | 6.000 | | 96 | WERL |
| AS | Full | 6B | | 1000-10000 | 3 | 52.000 | | 98.5 | WERL |
| AS | Pilot | 192D | | 1000-10000 | | 110.000 | | 94.3 | WERL |
| AS | Pilot | 192D | | 100-1000 | | 270.000 | | 37 | WERL |
| AS | Full | 6B | | 100-1000 | 330 | 35.000 | | 96.2 | WERL |
| AS | Full | 1B | | 100-1000 | 2 | 5.000 | | 96.2 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 2.000 | | 94.3 | WERL |
| AS | Full | 6B | | 1000-10000 | 4 | 16.000 | | 99.33 | WERL |
| AS | Bench | 200B | | 100-1000 | 14 | 8.000 | | 92.7 | WERL |
| AS | Full | 1B | | 100-1000 | 5 | 10.000 | | 91.7 | WERL |
| AS | Full | 1587E | | 0-100 | | 1.200 | | 79 | WERL |
| AS | Bench | 202D | | 10000-100000 | | 50.000 | | 99.94 | WERL |
| AS | Pilot | 241B | | 100-1000 | 10 | 25.000 | | 93.2 | WERL |
| AS | Bench | 1050E | | 100-1000 | 5 | 1.600 | | 99.6 | WERL |
| AS | Full | 375E | | 0-100 | 7 | 5.000 | | 67 | WERL |
| AS | Full | 6B | | 100-1000 | 3 | 10.000 | | 92.9 | WERL |
| AS | Bench | 1054E | | 100-1000 | | 8.000 | | 98.4 | WERL |
| AirS | Bench | 1328E | | 10000-100000 | 5 | 6200.000 | | 74 | WERL |
| AirS | Pilot | 222B | | 0-100 | 1 | 0.500 | | 83 | WERL |
| BGAC | Bench | 501A | | 0-100 | 34 | 0.310 | | 96.8 | WERL |
| BT | Full | P246 | | 768-2801 | 14 | 596.000 | | | BDAT # |
| * BT | Full | P202 | | 1350-4387 | 4 | 16.000 | | | BDAT # * |
| BT | Full | P206 | | 233-2333 | 10 | 88.000 | | | BDAT # |
| BT+AC | Full | P246 | | 768-3275 | 17 | 176.000 | | | BDAT # |
| GAC | Full | 245B | | 100-1000 | 1 | 10.000 | | 98.9 | WERL |
| GAC | Full | 1421D | | 0-100 | | 0.270 | | 90 | WERL |
| PACT | Bench | 242E | | 0-100 | | 5.000 | | 83 | WERL |
| PACT | Bench | 200B | | 100-1000 | 14 | 2.900 | | 97.5 | WERL |
| PACT | Full | 6B | | 1000-10000 | 10 | 88.000 | | 98.5 | WERL |
| PACT | Full | 6B | | 100-1000 | 4 | 64.000 | | 90 | WERL |
| RBC | Pilot | 192D | | 100-1000 | | 10.000 | | 97.7 | WERL |
| RO | Pilot | 323B | | 0-100 | 1 | 11.000 | | 70 | WERL |
| RO | Pilot | 180A | | 0-100 | | 0.090 | | 92.5 | WERL |
| WOx | Bench | Zimpro | | 590000 | 1 | 150000.000 | | 74.6 | WAO |
| WOx | Bench | Zimpro | | 6530000 | 1 | 2017000.000 | | 69.1 | WAO |
| WOx | Pilot | 78D | | >1000000 | | 29000.000 | | 98.7 | WERL |

# ITD data presented in the BDAT Solvents Rule F001-F005 Background Document.

WASTEWATER TREATMENT PERFORMANCE DATA
FOR DIETHYL PHTHALATE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AS | Pilot | 204A | | 0-100 | 8 | 1.200 | | 97.4 | WERL |
| AS | Full | 6B | | 1000-10000 | 36 | 28.000 | | 97.7 | WERL |
| AS | Pilot | 241B | | 100-1000 | 11 | 12.000 | | 97.6 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 1.000 | | 96.7 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 3.000 | | 88 | WERL |
| * BT | Full | 948 | 10 | 14-15000 | 33 | 23.500 | | | ITD-L * |
| PACT | Bench | Zimpro | | 88 | 1 | 1.000 | | 98.9 | NAO |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR DIMETHYL PHTHALATE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AS | Full | 1B | | 100-1000 | 1 | 2.000 | | 98.2 | WERL |
| AS | Full | 6B | | 100-1000 | 16 | 20.000 | | 92.8 | WERL |
| AS | Pilot | 241B | | 100-1000 | 10 | 13.000 | | 97.7 | WERL |
| AS | Pilot | 204A | | 0-100 | 8 | 0.800 | | 98.3 | WERL |
| AS | Full | 1B | | 0-100 | 1 | 30.000 | | 12 | WERL |
| * BT | Full | 948 | 10 | 10-625 | 22 | 10.000 | | | ITD-L * |
| PACT | Bench | Zimpro | | 332 | 1 | 1.000 | | 99.7 | WAO |
| WOx | Full | Zimpro | 1 | 61000 | 1 | 0.000 | | | WAO |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR DI-n-BUTYL PHTHALATE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AL | Bench | 371D | | 100-1000 | | 5.000 | | 99.5 | WERL |
| AL | Pilot | 203A | | 0-100 | 11 | 14.000 | | 81 | WERL |
| AL | Pilot | 203A | | 0-100 | 11 | 44.000 | | 40 | WERL |
| AS | Pilot | 240A | | 0-100 | 12 | 8.000 | | 91.4 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 4.000 | | 91.7 | WERL |
| AS | Full | 975B | | 0-100 | | 3.000 | | 87 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 5.000 | | 94.4 | WERL |
| AS | Full | 201B | | 0-100 | 2 | 3.000 | | 93.5 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 5.000 | | 93.8 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 10.000 | | 87 | WERL |
| AS | Pilot | 204A | | 0-100 | 8 | 2.700 | | 93.9 | WERL |
| AS | Pilot | 203A | | 0-100 | 11 | 7.000 | | 90.4 | WERL |
| AS | Full | 6B | | 100-1000 | 31 | 13.000 | | 96.8 | WERL |
| AS | Pilot | 241B | | 100-1000 | 11 | 17.000 | | 96 | WERL |
| AS | Bench | 1050E | | 100-1000 | 5 | 2.400 | | 99.4 | WERL |
| AS | Full | 6B | | 1000-10000 | 6 | 30.000 | | 98.7 | WERL |
| CAC | Pilot | 203A | | 0-100 | 11 | 47.000 | | 36 | WERL |
| ChOx | Bench | 975B | | 0-100 | | 3.000 | | 87 | WERL |
| * BT | Full | 948 | 10 | 19-2000 | 33 | 13.000 | | | ITD-L * |
| TF | Full | 1B | | 0-100 | 5 | 6.000 | | 92.6 | WERL |
| TF | Full | 1B | | 0-100 | 3 | 20.000 | | 70 | WERL |
| TF | Pilot | 203A | | 0-100 | 11 | 52.000 | | 29 | WERL |
| TF | Pilot | 240A | | 0-100 | 11 | 16.000 | | 81 | WERL |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR DI-n-OCTYL PHTHALATE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| | | MA0005304 | | | 21 | 9.810 | | | NPDES |
| | | LA0065501 | | | 6 | 10.000 | | | NPDES |
| | | LA0066214 | | | 15 | 10.000 | | | NPDES |
| | | MS0001970 | | | 1 | 110.000 | | | NPDES |
| | | OH0002445 | | | 6 | 5.717 | | | NPDES |
| | | WI0044636 | | | 1 | 47000.000 | | | NPDES |
| | | NY0004138 | | | 5 | 48.000 | | | NPDES |
| | | OH0002445 | | | 1 | 4.000 | | | NPDES |
| AL | Bench | 371D | | 1000-10000 | | 48.000 | | 97.6 | WERL |
| AS | Full | 1B | | 0-100 | 2 | 12.000 | | 79 | WERL |
| AS | Pilot | 204A | | 0-100 | 8 | 4.800 | | 83 | WERL |
| AS | Full | 1B | | 100-1000 | 1 | 3.000 | | 98.6 | WERL |
| BT | Full | LA0038245 | | | 38 | 9.961 | | | NPDES |
| ChOx | Bench | 975B | | 1000-10000 | | 360.000 | | 80 | WERL |
| PACT | Bench | 975B | | 1000-10000 | | 3.000 | | 99.75 | WERL |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR NAPHTHALENE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AL | Pilot | 192D | | 0-100 | | 10.000 | | 82 | WERL |
| AL | Bench | 371D | | 100-1000 | | 23.000 | | 97.7 | WERL |
| AL | Pilot | 192D | | 100-1000 | | 25.000 | | 96.5 | WERL |
| AL | Pilot | 203A | | 100-1000 | 11 | 13.000 | | 88 | WERL |
| AL | Pilot | 203A | | 100-1000 | 11 | 36.000 | | 67 | WERL |
| AL+AL | Full | 233D | | 100-1000 | 21 | 16.000 | | 98.3 | WERL |
| AS | Full | 201B | | 0-100 | 11 | 5.000 | | 89 | WERL |
| AS | Full | 6B | | 100-1000 | 2 | 14.000 | | 95.9 | WERL |
| AS | Bench | 1050E | | 100-1000 | 5 | 2.000 | | 99.5 | WERL |
| AS | Pilot | 241B | | 100-1000 | 11 | 8.900 | | 97.9 | WERL |
| AS | Pilot | 241B | | 100-1000 | 5 | 10.000 | | 93 | WERL |
| AS | Full | 975B | | 100-1000 | | 1.000 | | 99.17 | WERL |
| AS | Pilot | 204A | | 0-100 | 8 | 0.700 | | 99.09 | WERL |
| AS | Bench | 202D | | 1000-10000 | | 10.000 | | 99.86 | WERL |
| AS | Pilot | 203A | | 100-1000 | 11 | 4.000 | | 96.3 | WERL |
| AS | Pilot | 240A | | 100-1000 | 12 | 6.000 | | 95 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 9.000 | | 86 | WERL |
| AS | Full | 1B | | 100-1000 | 5 | 10.000 | | 95.4 | WERL |
| AS | Full | 6B | | 10000-100000 | 14 | 10.000 | | 99.95 | WERL |
| AS | Full | 6B | | 100-1000 | 13 | 10.000 | | 99 | WERL |
| AS | Pilot | 192D | | 0-100 | | 10.000 | | 82 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 3.000 | | 91.9 | WERL |
| AS | Full | 6B | | 1000-10000 | 7 | 10.000 | | 99.56 | WERL |
| AS | Full | 6B | | 100-1000 | 3 | 10.000 | | 96 | WERL |
| AS | Pilot | 192D | | 100-1000 | | 25.000 | | 96.5 | WERL |
| AirS | Bench | 1328E | | 10000-100000 | 5 | 6200.000 | | 74 | WERL |
| CAC | Pilot | 203A | | 100-1000 | 11 | 79.000 | | 27 | WERL |
| ChOx | Bench | 975B | | 0-100 | | 2.000 | | 88 | WERL |
| * BT | Full | 1293 | 10 | 11227-37145 | 15 | 10.000 | | | ITD-L * |
| PACT | Bench | Zimpro | | 191 | 1 | 1.000 | | 99.9 | WAO |
| RBC | Pilot | 192D | | 0-100 | | 10.000 | | 82 | WERL |
| RO | Pilot | 180A | | 0-100 | | 0.020 | | 80 | WERL |
| TF | Pilot | 240A | | 100-1000 | 11 | 14.000 | | 88 | WERL |
| TF | Full | 1B | | 0-100 | 6 | 3.000 | | 89 | WERL |
| TF | Pilot | 203A | | 100-1000 | 11 | 74.000 | | 32 | WERL |
| WOx | Full | Zimpro | 6 | 1200 | 1 | 210.000 | | | WAO |

## WASTEWATER TREATMENT PERFORMANCE DATA FOR NITROBENZENE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AL | Bench | 371D | | 1000-10000 | | 69.000 | | 97.7 | WERL |
| AS | Full | 975B | | 100-1000 | | 96.000 | | 72 | WERL |
| AS | Full | 6B | | 1000-10000 | 330 | 120.000 | | 96.1 | WERL |
| AS | Full | 6B | | 10000-100000 | 3 | 150.000 | | 99.8 | WERL |
| AS | Bench | 202D | | 10000-100000 | | 2200.000 | | 97.8 | WERL |
| AS | Bench | 200B | | 100-1000 | 16 | 3.000 | | 97.5 | WERL |
| AS | Full | 975B | | 100-1000 | | 3.400 | | 99.48 | WERL |
| AS | Full | 6B | | 1000-10000 | 28 | 14.000 | | 99.78 | WERL |
| AS | Pilot | 241B | | 100-1000 | 4 | 10.000 | | 92.3 | WERL |
| AS | Full | 1B | | 100-1000 | 1 | 23.000 | | 90 | WERL |
| AS | Pilot | 241B | | 100-1000 | 10 | 32.000 | | 92.8 | WERL |
| AirS | Bench | 1328E | | 100000-1000000 | 5 | 96000.000 | | 16 | WERL |
| BT | Full | P246 | | 821-5559 | 14 | 737.000 | | | BDAT ◊ |
| BT+AC | Full | P246 | | 821-90500 | 18 | 297.000 | | | BDAT ◊ |
| ChOx | Bench | 975B | | 0-100 | | 2.000 | | 95.9 | WERL |
| LL | Full | K104 | 30 | 2200000-3900000 | 5 | 2420000.000 | 115 | | BDAT |
| LL | Full | K103 | 30 | 1500000-3000000 | 5 | 2200000.000 | 115 | | BDAT |
| LL+SS | Full | K103/K104 | 30 | 1500000-3900000 | 5 | 2400.000 | 115 | | BDAT |
| LL+SS+AC | Full | K103/K104 | 30 | 1500000-3900000 | 4 | 30.000 | 115 | | BDAT |
| PACT | Bench | 190E | | 100-1000 | | 21.000 | | 96 | WERL |
| PACT | Full | 6B | | 1000-10000 | 4 | 14.000 | | 98.8 | WERL |
| PACT | Bench | 975B | | 100-1000 | | 2.000 | | 98.3 | WERL |
| PACT | Bench | 200B | | 100-1000 | 12 | 3.700 | | 96.7 | WERL |
| SCOx | Pilot | 65D | | 1000000 | | 22.000 | | 99.99 | WERL |
| SS | Full | P297 | | 87000-330000 | 10 | 11793.000 | | | BDAT ◊ |
| SS | Full | P246 | | 91200-1965760 | 15 | 251325.000 | | | BDAT ◊ |
| * SS+AC | Full | 500 | 14 | 14-5460000 | 37 | 520.300 | | | ITD-L * |
| * SS+AC | Full | 2680 | 14 | 87000-330000 | 10 | 712.600 | | | ITD-L * |
| SS+AC | Full | P297 | | 87000-330000 | 10 | 713.000 | | | BDAT ◊ |
| WOx | Bench | Zimpro | | 5125000 | 1 | 255000.000 | | 95 | WAO |

◊ ITD data presented in the BDAT Solvents Rule F001-F005 Background Document.

WASTEWATER TREATMENT PERFORMANCE DATA
FOR CHROMIUM (TOTAL)

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AL | Full | 1B | | 100-10000 | 6 | 130.000 | | 89.00 | WERL |
| AS | Full | 234A | | 0-100 | 7 | 7.000 | | 84.00 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 29.000 | | 64.00 | WERL |
| AS | Full | 167E | | 0-100 | | 9.000 | | 72.00 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 5.000 | | 90.90 | WERL |
| AS | Full | 1B | | 0-100 | 7 | 22.000 | | 69.00 | WERL |
| AS | Full | 234A | | 0-100 | 7 | 16.000 | | 82.00 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 6.000 | | 85.00 | WERL |
| AS | Full | 167E | | 0-100 | | 3.000 | | 96.10 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 12.000 | | 76.00 | WERL |
| AS | Full | 243A | | 0-100 | | 12.000 | | 83.00 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 36.000 | | 62.00 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 35.000 | | 65.00 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 6.000 | | 89.00 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 11.000 | | 78.00 | WERL |
| AS | Full | 234A | | 0-100 | 7 | 34.000 | | 58.00 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 36.000 | | 64.00 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 24.000 | | 70.00 | WERL |
| AS | Full | 198E | | 0-100 | 33 | 40.000 | | 79.00 | WERL |
| AS | Full | 234A | | 0-100 | 7 | 3.000 | | 94.60 | WERL |
| AS | Full | 234A | | 100-1000 | 7 | 14.000 | | 89.00 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 16.000 | | 87.00 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 40.000 | | 76.00 | WERL |
| AS | Full | 243A | | 100-1000 | | 28.000 | | 77.00 | WERL |
| AS | Full | 1B | | 1000-10000 | 6 | 62.000 | | 95.60 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 59.000 | | 86.00 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 19.000 | | 89.00 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 38.000 | | 84.00 | WERL |
| AS | Full | 167E | | 100-1000 | | 6.000 | | 98.50 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 16.000 | | 90.00 | WERL |
| AS | Full | 167E | | 100-1000 | | 12.000 | | 92.30 | WERL |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR CHROMIUM (TOTAL)

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AS | Full | 1B | | 100-1000 | 6 | 48.000 | | 88.00 | WERL |
| AS | Pilot | 1294B | | 1000-10000 | 3 | 390.000 | | 64.00 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 26.000 | | 80.00 | WERL |
| AS | Full | 1B | | 1000-10000 | 6 | 110.000 | | 97.40 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 52.000 | | 82.00 | WERL |
| AS | Full | 1B | | 1000-10000 | 96 | 140.000 | | 90.00 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 19.000 | | 83.00 | WERL |
| AS | Full | 201B | | 100-1000 | 35 | 51.000 | | 77.00 | WERL |
| AS | Full | 234A | | 100-1000 | 7 | 20.000 | | 82.00 | WERL |
| AS | Full | 1B | | 100-1000 | 7 | 46.000 | | 89.00 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 28.000 | | 93.50 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 35.000 | | 68.00 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 50.000 | | 54.00 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 19.000 | | 88.00 | WERL |
| CAC | Full | 393A | | 100-1000 | | 40.000 | | 94.10 | WERL |
| CAC (B) | Bench | 638B | | 100-1000 | 1 | 50.000 | | 62.00 | WERL |
| ChOx/Pt (B) | Bench | 248A | | 1000-10000 | 1 | 0.500 | | 74.00 | WERL |
| ChPt | Full | 245B | | 10000-100000 | 1 | 34.000 | | 99.95 | WERL |
| ChPt (B) | Pilot | 254B | | 100-1000 | 16 | 77.000 | | 76.00 | WERL |
| ChPt (B) | Pilot | 254B | | 10000-100000 | 14 | 170.000 | | 99.66 | WERL |
| ChPt+Fil (B) | Pilot | 254B | | 10000-100000 | 14 | 47.000 | | 99.91 | WERL |
| ChPt+Fil (B) | Pilot | 254B | | 100-1000 | 16 | 73.000 | | 77.00 | WERL |
| Chred/Pt+Sed+Fil | Full | K062 | | 70-917000 | 9 | 57.000 | | | BDAT |
| Chred/Pt+Sed+Fil | Full | K062 | | 6000-7000000 | 11 | 135.000 | 68.0 | | BDAT |
| Fil | Pilot | 254B | | 100-1000 | 14 | 39.000 | | 90.20 | WERL |
| L+Sed | Full | | | 100-116000 | | 84.000 | | | ITD-CMDB |
| * L+Sed+Fil | Full | | | 100-116000 | | 70.000 | | | ITD-CMDB * |
| PACT | Pilot | 1294B | | 1000-10000 | 3 | 320.000 | | 71.00 | WERL |
| Pt+Sed | Full | | 50 | 0-35400 | 38 | 572.000 | | | ITD-MF |
| Sed | Pilot | 1294B | | 1000-10000 | 3 | 1100.000 | | 66.00 | WERL |
| Sed+Fil | Full | | | 100-116000 | | 80.000 | | | ITD-CMDB |
| TF | Full | 1B | | 100-1000 | 6 | 57.000 | | 56.00 | WERL |
| TF | Full | 1B | | 100-1000 | 6 | 34.000 | | 69.00 | WERL |
| TF | Full | 1B | | 0-100 | 6 | 15.000 | | 67.00 | WERL |
| TF | Full | 1B | | 100-1000 | 6 | 92.000 | | 23.00 | WERL |
| TF | Full | 1B | | 100-1000 | 6 | 180.000 | | 25.00 | WERL |
| TF | Full | 1B | | 100-1000 | 6 | 44.000 | | 71.00 | WERL |
| TF | Full | 1B | | 0-100 | 6 | 17.000 | | 48.00 | WERL |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR LEAD

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AS | Full | 1B | | 100-1000 | 6 | 86.000 | | 57.00 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 20.000 | | 66.00 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 20.000 | | 66.00 | WERL |
| AS | Full | 201B | | 0-100 | 10 | 50.000 | | 34.00 | WERL |
| AS | Full | 167E | | 100-1000 | | 16.000 | | 86.00 | WERL |
| AS | Full | 167E | | 0-100 | | 17.000 | | 73.00 | WERL |
| AS | Full | 234A | | 0-100 | 7 | 1.000 | | 98.70 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 50.000 | | 50.00 | WERL |
| AS | Full | 167E | | 100-1000 | | 12.000 | | 90.20 | WERL |
| AS | Full | 234A | | 0-100 | 7 | 1.000 | | 98.50 | WERL |
| AS | Full | 1B | | 1000-10000 | 6 | 59.000 | | 95.10 | WERL |
| AS | Full | 167E | | 0-100 | | 21.000 | | 52.00 | WERL |
| AS | Full | 234A | | 0-100 | 7 | 0.000 | | 98.00 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 20.000 | | 70.00 | WERL |
| AS | Full | 243A | | 0-100 | | 5.400 | | 88.00 | WERL |
| AS | Full | 201B | | 100-1000 | 6 | 70.000 | | 50.00 | WERL |
| AS | Full | 234A | | 0-100 | 7 | 1.000 | | 97.80 | WERL |
| AS | Pilot | 1294B | | 1000-10000 | 3 | 650.000 | | 68.00 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 44.000 | | 52.00 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 25.000 | | 88.00 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 20.000 | | 64.00 | WERL |
| AS | Full | 198E | | 0-100 | 33 | 40.000 | | 50.00 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 70.000 | | 50.00 | WERL |
| AS | Full | 243A | | 0-100 | | 2.200 | | 92.10 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 47.000 | | 75.00 | WERL |
| AS | Full | 234A | | 0-100 | 7 | 1.000 | | 97.80 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 24.000 | | 70.00 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 56.000 | | 57.00 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 30.000 | | 79.00 | WERL |
| AS | Full | 975B | | 100-1000 | | 66.000 | | 40.00 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 92.000 | | 23.00 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 53.000 | | 67.00 | WERL |
| CAC | Full | 393A | | 100-1000 | | 32.000 | | 87.00 | WERL |
| Chred/Pt+Sed+Fil | Full | K062 | | 10000-212000 | 11 | 10.000 | 76 | | BDAT |
| Fil | Pilot | 254B | | 100-1000 | 14 | 100.000 | | 63.00 | WERL |
| L+Sed | Full | | | 100-29200 | | 120.000 | | | ITD-CMDB |
| * L+Sed+Fil | Full | | | 100-29200 | | 80.000 | | | ITD-CMDB * |
| PACT | Pilot | 1294B | | 1000-10000 | 3 | 500.000 | | 75.00 | WERL |
| Pt+Sed | Full | | 100 | 0-42300 | 44 | 200.000 | | | ITD-MF |
| Sed | Pilot | 1294B | | 1000-10000 | 3 | 2000.000 | | 78.00 | WERL |
| Sed+Fil | Full | | | 100-29200 | | 30.000 | | | ITD-CMDB |
| TF | Full | 1B | | 0-100 | 6 | 20.000 | | 75.00 | WERL |
| TF | Full | 1B | | 100-1000 | 6 | 130.000 | | 19.00 | WERL |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR CYANIDE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AL | Full | 1B | | 0-100 | 6 | 10.000 | | 88 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 10.000 | | 91.7 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 160.000 | | 53 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 65.000 | | 59 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 320.000 | | 29 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 150.000 | | 70 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 27.000 | | 67 | WERL |
| AS | Full | 201B | | 0-100 | 28 | 90.000 | | 0 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 54.000 | | 79 | WERL |
| AS | Full | 167E | | 0-100 | | 19.000 | | 44 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 5.000 | | 58 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 47.000 | | 88 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 110.000 | | 59 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 110.000 | | 35 | WERL |
| AS | Full | 1B | | 1000-10000 | 6 | 110.000 | | 97.7 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 24.000 | | 35 | WERL |
| AS | Full | 160A | | 100-1000 | 60 | 79.000 | | 55 | WERL |
| AS | Full | 1B | | 1000-10000 | 6 | 130.000 | | 91.9 | WERL |
| AS | Full | 167E | | 100-1000 | | 20.000 | | 88 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 41.000 | | 42 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 370.000 | | 58 | WERL |
| AS | Full | 1B | | 0-100 | 7 | 6.000 | | 65 | WERL |
| AS | Full | 201B | | 1000-10000 | 6 | 110.000 | | 97.7 | WERL |
| AS | Full | 167E | | 100-1000 | | 22.000 | | 80 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 250.000 | | 65 | WERL |
| AS | Full | 167E | | 100-1000 | | 110.000 | | 64 | WERL |
| AS | Full | 1B | | 1000-10000 | 6 | 240.000 | | 80 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 7.000 | | 75 | WERL |
| AS | Full | 160A | | 0-100 | 60 | 8.000 | | 91 | WERL |

WASTEWATER TREATMENT PERFORMANCE DATA
FOR CYANIDE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AS | Full | 1B | | 1000-10000 | 6 | 220.000 | | 90 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 87.000 | | 64 | WERL |
| AS | Full | 1B | | 1000-10000 | 6 | 380.000 | | 71 | WERL |
| ChOx(Cl) | Pilot | 1077B | | 10000-100000 | 20 | 6700.000 | | 92.4 | WERL |
| ChOx/Pt (B) | Bench | 248A | | >1000000 | 1 | 1000.000 | | 100 | WERL |
| ChOx/Pt (B) | Bench | 248A | | >1000000 | 1 | 100.000 | | 100 | WERL |
| * CN/Ox | Full | | 5-20 | 45-1680000 | 1529 | 180.00 | | | ITD-MF * |
| LL+SS | Full | K103/K104 | | 10-6280 | 5 | 2960.000 | 72 | | BDAT |
| LL+SS+AC | Full | K103/K104 | | 10-6280 | 4 | 362.000 | 72 | | BDAT |
| L+Sed | Full | | | 120-3280 | | 70.00 | | | ITD-CMDB |
| L+Sed+Fil | Full | | | 120-3280 | | 47.00 | | | ITD-CMDB |
| RBC | Full | 1B | | 1000-10000 | 6 | 84.000 | | 95.8 | WERL |
| SS | Pilot | 1082E | | 10000-100000 | | 39000.000 | | 38 | WERL |
| TF | Full | 1B | | 100-1000 | 6 | 130.000 | | 65 | WERL |
| TF | Full | 1B | | 100-1000 | 6 | 47.000 | | 74 | WERL |
| TF | Full | 1B | | 100-1000 | 6 | 310.000 | | 56 | WERL |
| TF | Full | 1B | | 100-1000 | 6 | 110.000 | | 59 | WERL |
| TF | Full | 1B | | 0-100 | 6 | 17.000 | | 39 | WERL |
| TF | Full | 1B | | 0-100 | 6 | 53.000 | | 36 | WERL |
| WOx | Pilot | 78D | | 100000-1000000 | | 6000.000 | | 98 | WERL |
| WOx (B) | Bench | 1054E | | 10000-100000 | | 1200.000 | | 98.7 | WERL |
| WOx (B) | Bench | 1054E | | >1000000 | | 170.000 | | 100 | WERL |